SCIENTIFIC AMERICAN

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Vol. C.—No. 1.
ESTABLISHED 1845.

NEW YORK, JANUARY 2, 1909.

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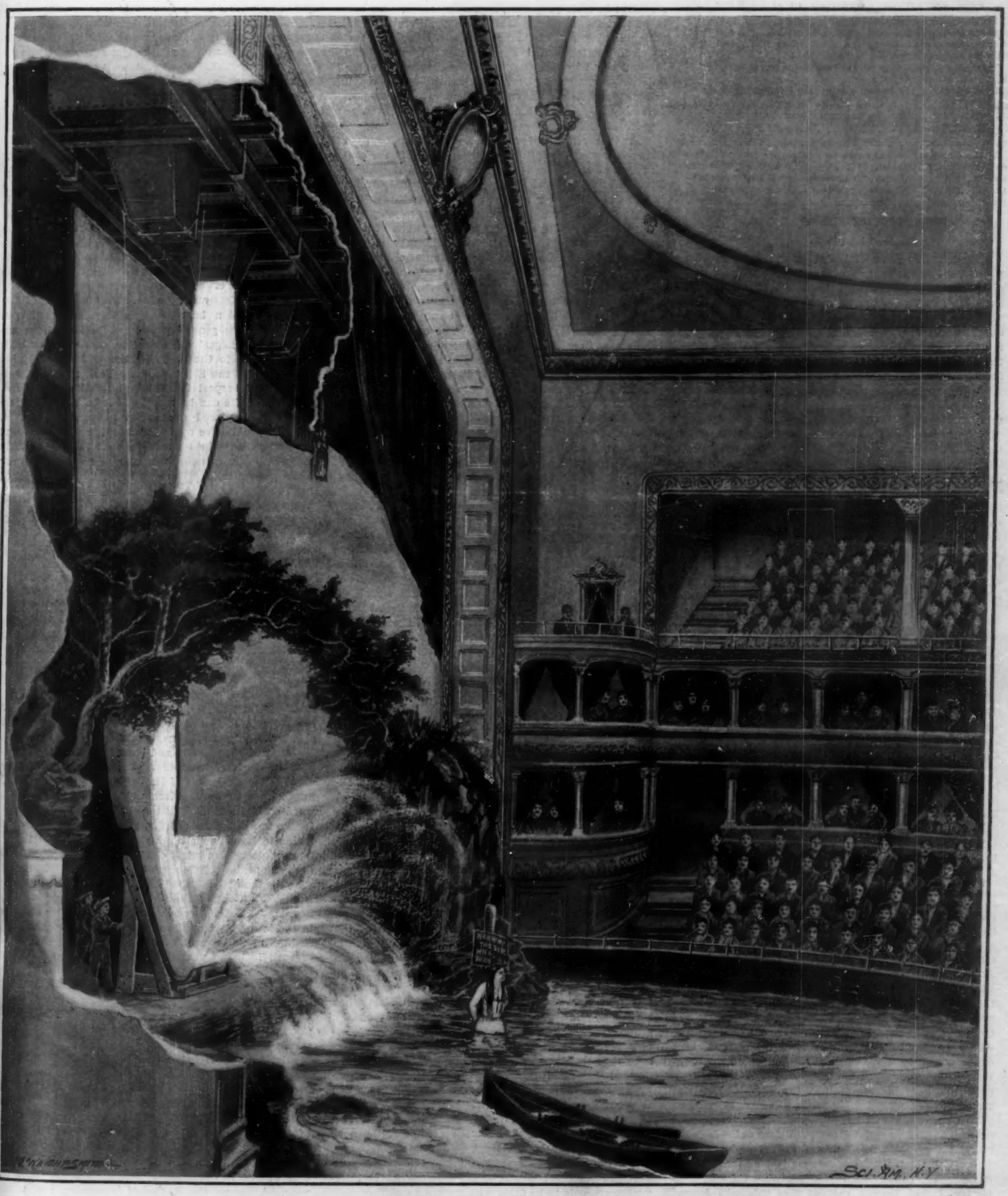

Forty-five tons of water are dropped from overhead tanks on a wave-forming board and projected into the arena.

THE GREAT WAVE SCENE AT THE LONDON HIPPODROME.—[See page 8.]

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MUNN & CO. - - Editors and Proprietors

Published Weekly at
No. 361 Broadway, New York

CHARLES ALLEN MUNN, *President*,
361 Broadway, New York.
FREDERICK CONVERSE BEACH, *Sec'y and Treas.*
361 Broadway, New York.

TERMS TO SUBSCRIBERS.

One copy, one year, for the United States or Mexico $3.00
One copy, one year, for Canada 3.75
One copy, one year, to any foreign country, postage prepaid, 18s. 6d. 4.50

THE SCIENTIFIC AMERICAN PUBLICATIONS.

Scientific American (established 1845) ..... $3.00 a year
Scientific American Supplement (established 1876) ..... 5.00 "
American Homes and Gardens ..... 3.00 "
Scientific American Export Edition (established 1878) ..... 3.00 "

The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon application.

Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JANUARY 2, 1909.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RETROSPECT OF THE YEAR 1908.

Industrial Conditions.

Although the industrial and financial depression which marked the early months of the past year was deplorable, there is some satisfaction to be derived from the fact that the commercial fabric of the country, considered as a whole, has passed through such an exceedingly trying ordeal with so comparatively few disasters of the first magnitude; a result which testifies to the greater stability of our financial and industrial institutions, and proves that the people as a whole are less liable than formerly to become the prey of a wild, unreasoning panic. Institutions which in former periods of financial stringency would have gone down into irretrievable ruin, have passed through their period of receivership, and, after reorganization, have resumed their activities upon a sounder basis and with every confidence of future permanence. The closing months of the year have witnessed a gradual, but unmistakable improvement in conditions, the most encouraging feature of which is the absence of that tendency toward artificial stimulation of business, which has been one of the marked features of recovery from the panics of former years. This spirit of conservatism augurs well for the permanence of the era of prosperity upon which we have undoubtedly entered.

Civil Engineering.

Of all branches of industrial activity, those which are covered by civil engineering have ever been the first to feel, and the last to recover from, a period of depression. During the greater part of the year a great amount of engineering work was either closed down altogether, or the force was reduced to what was necessary merely to keep the plants in order and prosecute such work as was absolutely necessary. One of the most encouraging signs of the present revival, however, is the fact that most of these enterprises are again being carried forward on something of the extensive scale which marked the activity of the preceding year.

PANAMA CANAL.—In spite of the many alarmist rumors which have recently been started regarding conditions on the Panama Canal, it may be stated, without any qualification, that the work has been carried on throughout the year at a speed and with a success beyond the most sanguine expectations. With the arrival on the Isthmus of the complete excavating plant and other collateral equipment, there was a remarkable acceleration of the work. The total quantities of monthly excavation rose from 2,709,613 cubic yards in January to a maximum of 3,480,270 cubic yards in March, the last being the highest monthly record for the year. With the advent of the rainy season there was a natural falling off in results; but the total for the month of November reached 2,920,494 cubic yards, which was the highest ever made in the rainy season, and was over 1,000,000 cubic yards more than the excavation in November of the previous year. If the present rate of work be maintained, the whole of the total amount of 142,000,000 cubic yards will have been taken out in about two and one-half years from the present date. The present satisfactory conditions at the Isthmus reflect the greatest credit upon the army engineers who, under Col. Goethals, have full control of the work of building the canal. As to the probable time of completion, it has become evident that this will depend upon the time necessary for constructing the Gatun dam and locks. The latest estimate of Col. Goethals sets the time for the opening of the canal for navigation in the early months of the year 1915. Several very important revisions have been made of the original plans, including an increase in the clear width of the locks to 110 feet and the usable length to 1,000 feet. At the Pacific end of the canal a revision has been made, which involves the sustitution for a flight of two locks at La Boca and one at Pedro Miguel of one at Pedro Miguel and two at Miraflores. The advantages of this plan are that the dams can be built of lower height and less length, and that they will be founded upon rock lying comparatively near the surface. Moreover, being further inland they will be protected against all possibility of distant bombardment from the sea. During the year exhaustive examinations have been made of all the lock sites and also of the site of the Gatun dam and spillway, with the result that the army engineers, who are always strictly conservative in their judgment, express themselves as satisfied that these structures will rest upon stable foundation having a wide margin of safety for carrying the load imposed. The excellent sanitary conditions brought about by Col. Gorgas have continued throughout the year, and the United States employees on the Isthmus are living under conditions which compare favorably in point of health with those of the average city in the United States.

WATER SUPPLY AND IRRIGATION.—There never was a time when so much activity was manifested in the construction of reservoirs for water supply and irrigation. Foremost among those designed for municipal service is the Catskill water supply which, when the whole scheme is completed, will be capable of supplying New York city daily with over 700 million gallons of pure mountain water. That portion of the scheme now under construction includes the building of a dam and reservoir with a full level capacity of 170 billion gallons, capable of supplying the city with 250 million gallons of water a day, and the construction of an aqueduct 17 feet in diameter and 90 miles in length from the reservoir to New York. The construction of the dam and certain sections of the aqueduct is under way, and the present indications are that water will be delivered into the Croton watershed within the next five years, and that the aqueduct will be completed to the city within the next seven or eight years. During the year rapid progress has been made on the Croton Falls reservoir, in the Croton watershed, which will add an additional 14 million gallons of storage, bringing the total storage capacity of the watershed up to 104,530,000 gallons. The most important national undertaking of the time is the work being done by the United States Reclamation Service in the irrigation of so-called desert lands. The whole scheme when completed will render available for cultivation nearly 5,000 square miles of land which now is barren for want of water. The work is widely distributed and includes no less than twenty-five separate projects in the States lying west of the Mississippi River. The most important of these involve the reclaiming of from 100,000 to 400,000 acres of land, and will necessitate the construction of some of the loftiest dams and largest reservoirs in the world. Excellent progress has been made during the year, particularly upon the great Roosevelt dam, a masonry structure 284 feet in height and 1,080 feet long, which will store 1,284,000 acre-feet of water. Two other notable dams are the Shoshone, 326 feet in height, which will store about half a million acre-feet, and the Pathfinder, 215 feet high, with a storage capacity of over 1,000,000 acre-feet. The New York State Barge Canal, which, because of its great length of 442 miles, must be considered one of the greatest undertakings of the kind in history, is at last making something like satisfactory progress. It is being built with a least depth of 12 feet and a least bottom width of 75 feet to accommodate barges of 1,000 tons capacity. Leaving Lake Erie at an elevation of 565.6 feet above sea level, it enters the Hudson River near Albany at tide level. It requires the excavation of 133,000,000 cubic yards of material, and its total estimated cost will be $101,000,000. During the summer material was excavated at the rate of over 1,000,000 cubic yards per month, which is about equal to the amount taken out at Panama during the corresponding year of active operations. The work of increasing the height of the Assouan dam in Egypt, as planned by the late Sir Benjamin Baker, has been made the subject of spirited criticism on the ground that it will be impossible to secure a satisfactory bond between the old and the new work. To insure that the dam would have ample stability, it was decided to widen it by 15 feet, building the new masonry upon the apron which was built a few years ago to protect the toe of the dam from erosion. The additional work is being built with an 8-inch space between the face of the old work and that of the new, the two portions being tied together by steel beams. When the new work has been completed and its temperature has reached that of the older work, the intervening space is to be filled with concrete and thoroughly grouted up.

BRIDGES.—It begins to look as though in the domain of bridge construction our annual review was to be a record of disaster or failure, at least as regards bridges of the first magnitude. Last year the most notable event was unquestionably the tragic fall of the Quebec bridge, and certainly the most sensational event of the present year was the discovery by a special commission that the other mammoth cantilever structure, that across the East River at Blackwell's Island, would, if completed upon the present plans, have been even more seriously overstressed in some of its members than was the Quebec bridge. Coming so soon after the Quebec failure, the Blackwell's Island fiasco has struck a severe blow at the prestige of American bridge building. It is but fair to point out, however, that had it not been for the pernicious effect of political changes upon the Bridge Department of this city this magnificent structure would not be in its present deplorable condition. Nevertheless, it is a fact that experience with the Quebec and Blackwell's Island bridges has produced a certain revulsion of feeling on the part of bridge engineers against the cantilever system for bridges of over 1,000 feet span, particularly where the live load is of an unusually heavy character. Under these conditions the suspension bridge, with a well-stiffened floor system, presents undoubted advantages of economy and safety. During the year plans were made public for a mammoth arch bridge of reinforced concrete with a span of 703 feet, which it is proposed to build in this city as a memorial to Henry Hudson. As this span will be more than double that attempted in any previous arch bridge of the same type, it has been urged that, in view of our somewhat limited knowledge of the behavior of reinforced concrete, the erection of a bridge of this size involves no small amount of risk. On the other hand, the reinforcement constitutes in itself a steel arch of unusual strength and rigidity, and it is claimed by the designers that a collapse of the structure is thereby rendered practically impossible. The question of the construction of a bridge across the Hudson River, which engineers generally believed to have been answered in the negative for all time to come, has been again brought to the front by the action of a joint commission of the States of New York and New Jersey, which has reported in favor of building the bridge, if a suitable site can be found. If it be built, its location must be placed somewhere above 110th Street, since the prohibitive cost of real estate would prevent its erection anywhere south of that location. The bridge, moreover, must necessarily be reserved for vehicular, trolley, and foot passenger traffic, the cost of constructing it for the operation of heavy railway trains being too great for serious consideration.

The construction of a four-track railway arch bridge of 1,000 feet span across the East River at Hell Gate, after having been postponed on account of the recent financial stringency, is about to be undertaken by the Pennsylvania Railroad. This will be by far the largest and heaviest arch bridge of any kind in the world.

TUNNELS AND TERMINALS.—Progress on the large amount of tunnel and terminal work in and around New York city has been seriously delayed by the industrial depression. Both the Pennsylvania and the New York Central railroads have maintained a limited working force on both of their extensive projects, although with the bettering of conditions toward the close of the year, the working forces have been increased and the work pushed forward with considerable activity. The Pennsylvania tunnels beneath the Hudson and East Rivers and beneath Manhattan Island have been completed so far as the excavation is concerned, and the work of lining them with concrete is now in progress. The terminal station is well on toward completion, as far as the steel work and granite facing are concerned; but a vast amount of work remains to be done in the laying of tracks and the interior finish. The latest official announcement sets the date of opening of this system early in 1910. During the year the old trainshed of the Grand Central Station, New York Central Railroad, was removed; a large number of tracks were transferred from the old level to the lower level at the temporary Lexington Avenue station, and the work of excavating the 45-foot depth of rock is being pushed as rapidly as the restricted conditions will allow. At the present rate of progress it will take at least four years to complete the excavations and transfer the tracks to the new levels. During the year the northerly tunnels of the Hudson Companies system at Morton Street were opened for service, and at the present writing trains are running regularly from Hoboken to Twenty-third Street and Sixth Avenue, Manhattan. The connecting subway in Jersey City has been completed, as have also the two tunnels below the Hudson River from Jersey City to Cortlandt Street. At the present time a short length of tunnel remains to be completed between the ends of the river tunnels and the terminal station at Cortlandt Street. It is expected that this part of the system will be in operation by the early summer of this year. Although the financial depression has caused the abandonment, for the present, of the construction of extensions of the Rapid Transit Subway in Brooklyn, work has been steadily prosecuted on the Subway loop connecting the Manhattan ends of the Williams-

burg and Brooklyn bridges. The opening of the Subway tunnel from the Battery to Brooklyn, and the completion of the line to Flatbush Avenue, have served to lessen the congestion on the Brooklyn Bridge. The "Belmont " tunnel, at Forty-second Street, built under the old Steinway franchise, has been completed and is now under offer of purchase by the city for the sum of $7,000,000. The system of subways in Philadelphia has proved to be as great a success as that which is in operation in New York. Boston also is increasing its facilities, the most recent addition being a short stretch of subway, one mile in length, which, because of the difficulties of the site, has proved to be the most costly bit of tunneling ever built. Mention should be made of the railway tunnel which is making satisfactory progress beneath the Detroit River. The method of construction involves the dredging of a large trench, and the floating into position and sinking of steel tubes, around which is built up in place a mass of concrete which forms the tunnel proper.

Naval and Military.

In a review of the naval events of the year, the two facts which stand out with prominence, at least as far as the United States is concerned, are the remarkable cruise of the Atlantic Squadron around the world, and the acrimonious controversy which has been aroused as to the efficiency of the navy. The sweeping criticism of our ships had its origin among a few of the more progressive and ambitious of the younger men among the seagoing officers. The motives which prompted this criticism were, we believe, honorable and disinterested; but the manner of their presentment was about as unfortunate and deplorable as it could well be, the medium chosen being a popular magazine, and the writer a layman who allowed his zeal to run away with his discretion, and offered his arguments in a manner so marked by exaggeration and extravagance that he defeated the very object in view. That the ships of our navy are capable of improvement in certain particulars is undeniable; and had these improvements been suggested with moderation and a strict agreement with the facts, the criticisms would have been heard, and the ultimate results more quickly secured. In the long-drawn-out controversy which has ensued, the most important of the alleged defects have been disproved, and the fact established that our battleships are fully comparable with the ships of foreign navies of the same date of design. At the Newport Conference, which followed a few months after the Senate inquiry, it was also proved, if proof were necessary, that the designs of our latest ships of the "Dreadnought" type were not only abreast of the times, but that they have served in some particulars as a type which other naval powers are closely following. Perhaps the most significant tribute to the excellence of our navy was the punctual arrival of the battleship fleet at the various ports of call, and the even more important fact that the fleet to-day, in spite of its long and arduous cruise, is in excellent condition, the deterioration being only such as is inevitable in any fleet on a cruise of this great duration. Progress in the upbuilding of our navy during the year has been very satisfactory. The three scout cruisers "Birmingham," "Chester," and "Salem" have passed through their trials successfully. These vessels, of 4,580 tons displacement, were designed for a trial speed of 24 knots. The "Birmingham," equipped with twin reciprocating engines, averaged 24.32 knots on her four-hour trial; the "Chester," furnished with Parsons turbines, made 26.52 knots; and the "Salem," equipped with Curtis turbines, averaged 25.94 knots. These three ships are about to engage in a series of competitive trials, which will furnish data of unusual interest. During the year, all of our battleships under construction, except those of the "Dreadnought" type, have been completed; with the result that of the later designs we now possess six "Connecticuts," of 16,000 tons and 18 knots; two smaller "Connecticuts," the "Idaho" and "Mississippi," of 13,000 tons and 17 knots; and five "Virginias," of 15,000 tons and 19 knots speed. All of these ships carry modern 12-inch guns in the main battery, and a heavy intermediate battery of 8-inch guns. We have six "Dreadnoughts" under construction. The "South Carolina" and "Michigan," of 16,000 tons, carrying eight 12-inch guns, are about two-thirds completed; the "North Dakota," 20,000 tons, carrying ten 12-inch guns, has recently been launched; and her sister the "Delaware" will shortly take the water. The slips are now being prepared for the laying down of the 20,000-ton "Florida" and "Utah." The last report of the Chief of the Bureau of Ordnance states that our 45-caliber 12-inch gun is fully the equal of any mounted in any foreign navy; but in view of the fact that some of these navies have 12-inch 50-caliber pieces under construction, whose muzzle velocity will be from 3,000 to 3,100 foot-seconds as against 2,700 foot-seconds for our guns, it is evident that a new 12-inch piece should be designed. On the other hand, there is a movement on foot favoring the arming of our future "Dreadnoughts" with a new 14-inch piece; and it has been suggested that our next appropriations should be either for 20,000-ton ships carrying eight 14-inch guns, or 23,000-ton ships carrying ten 14-inch guns. Outside of the construction of battleships, our efforts are being devoted to the construction of sea-going torpedo boats and submarines. The United States is building no armored cruisers. The crying need of the navy to-day is for a fleet of large, fairly fast colliers. The Atlantic fleet, on its trip around the world, has to depend almost entirely on foreign tramp steamers for its coal supply. In time of war these would not be available. We have no merchant marine to speak of; and, in its absence, the construction of a fleet of colliers is as essential as the construction of battleships. Great Britain, with a total displacement of armored ships of 1,395,930 tons, continues to lead the world in the number, power, and quality of her ships; the United States being second with 607,241 tons, and France third, with 573,364 tons. If battleships alone be reckoned, Germany takes third rank. Great Britain records no failures. She serves as the great experimental ground for the world, and the ships which she evolves seem to stand as types for other nations. The "Dreadnought" has been followed by six other ships of the same general design, in which have been incorporated the experience gained during the extensive cruises of the "Dreadnought." Hitherto the British have not followed our system of mounting the 12-inch guns on the central line of the ship; though it is rumored that in their next ships they will incorporate this valuable feature. The most sensational success of the year was the brilliant performance of the battleship-cruisers "Invincible" and "Indomitable." Both of these, on their trials, made over 27 knots an hour, and the "Indomitable" crossed the Atlantic from Newfoundland to Southampton at an average speed of a fraction under 25 knots an hour. Sensational, also, were the speeds achieved by what is known as the tribal class of torpedo-boat destroyers, vessels of 750 tons, which steamed for six hours at average speeds of from 34 to 35.36 knots an hour, the "Tartar" on one run reaching a speed of slightly over 37 knots. Later in the year the ocean-destroyer "Swift," of 1,800 tons, maintained for some hours a speed of 38.3 knots, or between 44 and 45 miles an hour. It is probable that the next radical departure in warship construction will be the adoption of gas engines for motive power. Yarrow & Co. built during the year two 250-horse-power, gasoline-propelled gunboats for the Austro-Hungarian navy, and Beardmore & Co., of Glasgow, have equipped an old British gunboat, the "Rattler," with producer-gas engines, which, compared with the old steam plant, show a large saving in weight and fuel consumption and have driven the ship at a speed of between 11 and 12 knots an hour. Encouraged by this success they are installing producer-gas engines of greater power in another vessel, from which even better results are expected. The question of equipping a battleship with a plant of this kind cannot be settled, except by a gradual increase in the size of the equipment, until it has been proved that the various difficult problems incidental to a large marine producer-gas engine have been successfully mastered. The present indications are that this will eventually be done, and when it is, the efficiency of the warship will be vastly increased. There never was a time when naval powers exhibited so much activity in the enlargement of their fleets as just now, the greater part of the appropriations being devoted to the construction of battleships of the all-big-gun type. Outside of these, new constructions are being confined to fast scouts of about 5,000 tons displacement and 25 or 26 knots speed, destroyers of from 600 to 800 tons, and submarines. The development of the last-named type has been steady, both the size and speed having been materially increased during the year. It is gratifying to realize that the United States navy now holds the second position in fighting power. This is due to the fact that we have put most of our displacement into heavily-armed battleships; and if we continue to follow the proposed plan of building two battleships a year, we shall have no difficulty in maintaining this position.

Merchant Marine.

In respect of the addition of new merchant vessels of the first size and speed to the merchant marine, the past year has been less notable than its immediate predecessors; but it has been remarkable for the performances of some of the ships already afloat. Precedence is naturally taken by the two latest transatlantic liners, the "Lusitania" and "Mauretania," which, after the stormy experience of the winter, settled down to a steady run of record-breaking across the Atlantic. The most puzzling performance of the year was that of the "Mauretania," when, during a trip early in June, in which, because of an accident, she was run under only three out of her four propellers, she covered the longer northern route in four days, twenty hours, and twelve minutes, at an average speed of 24.86 knots, not only beating her own record made with four propellers, but also that of the sister ship "Lusitania"—a result which would seem to show that the boiler capacity of these vessels is not equal to that of the turbines. Later in the same month the "Lusitania," in making a passage in four days and fifteen hours, at an average speed of 25.04 knots, earned the distinction of being the first 25-knot transatlantic liner. On a subsequent trip the last-named vessel covered 650 knots in one day, at an average speed of 25.66 knots. The fact that the "Mauretania" made her best speed with one of her high-pressure turbines out of commission afforded further evidence that the most efficient work of the steam turbine is done in the low-pressure turbines, and confirmed the judgment of those marine engineers who believe that a combination of high-pressure reciprocating engines and low-pressure turbines will give the best results. Hence great interest attaches to the performance of the 14,500-ton "Laurentic," which was launched during the year for the transatlantic service of the White Star Line. Her motive power consists of two reciprocating engines driving two outside propellers, and a low-pressure turbine on the center line of the ship. Evidently, the limit of size in ocean steamers has not yet been reached; as witness the construction which has recently been commenced at the Belfast yard, of two ships, the "Olympic" and "Titanic," for the White Star Line, which are said to have the enormous dimensions of 930 feet over-all length, and 60,000 tons displacement. These vessels, also, will be driven by a combination of reciprocating and turbine engines, and they are expected to show a sea speed of 21 knots an hour. There is no indication of a desire on the part of any of the leading steamship companies to emulate the high-speed performance of the Cunard liners. The German companies seem to be satisfied with the 23¼ to 23½ knots speed of the "Kaiser Wilhelm II." and the "Cecilie"; and if they have any plans for winning back the blue ribbon of the Atlantic, nothing has been made public to that effect. The prevailing type of transatlantic liner of the future seems destined to be the combined freight and passenger steamer of moderate speed. Unfortunately, the American merchant marine remains in the moribund condition which has characterized it for many years past. In spite of the earnest support of the President, Congress failed to pass the measures which had been proposed with a view to its resuscitation. Meanwhile our merchant marine on the Pacific is being rapidly swept out of existence; and it is a fact which cannot be disputed that, were we suddenly to find ourselves engaged in a naval war, we would be terribly crippled for want of transports and colliers, to say nothing of a body of seamen from which to recruit the personnel.

Steam Railroads.

The depression of the past year was felt so severely by the steam railroads, that there has been but comparatively little new construction undertaken, the efforts of the railroads being directed mainly to the upkeep and improvement of track and equipment. An important agreement has been reached between the railroads and manufacturers on the question of the composition and rolling of steel rails, and, as an immediate consequence, orders have been once more coming freely to the mills. It is probable that the principle observed by the Pennsylvania Railroad Company in its new specifications will be followed pretty generally throughout the country. The most important feature of the specifications is the placing upon the manufacturers of more of the responsibility for the character of the rail produced. No specification is made as to the amount of crop from the ingot, and considerable latitude will be allowed in the methods of manufacture, it being merely provided that the rail be free from injurious mechanical defects and flaws. Track construction is being greatly improved by the more general introduction of steel tie-plates between the rail base and the tie; and it now remains for American railroads to adopt some form of screwed or bolted fastening in place of the present unsatisfactory spike, to render our best track comparable with the best that can be found in Europe. The rail spike must go, and the sooner the better. The steel car having demonstrated its good qualities for every kind of traffic, is now being introduced in considerable numbers. The steel Pullman car shows only a slight increase of weight over the wooden car, and it possesses the advantage of being practically unwreckable, and therefore a great safeguard to life and limb. Fashions change in locomotives, and just now the once popular Atlantic type is being discarded for heavy express service in favor of a six-coupled twelve-wheeled locomotive of greater hauling power. In freight locomotives there is a disposition to introduce more extensively the Mallet system, particularly on heavy mountain grades. The average speed of our fastest trains is still far below what it should be. This will be evident when we remember that both England and France have over fifty expresses

(*Continued on page 5.*)

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CARRIER PIGEONS AS PHOTOGRAPHERS.

BY THE BERLIN CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

An ingenious apothecary of Cronberg, Germany, as far back as in the forties of the last century, organized a carrier pigeon mail for the conveyance of prescriptions from the surrounding villages to his shop, and the same idea was taken up a few years ago by his son, Dr. Neubronner, who even extended it to the transport of small quantities of medicaments. Now the fact that one of his winged messengers once was delayed unexpectedly, suggested the idea of recording his route by means of photographic views. Dr. Neubronner accordingly provided the pigeon with a miniature camera, effecting by an automatically-opening shutter some very satisfactory photographic views, and this success induced him to design a special photographic apparatus illustrated herewith, which allows up to thirty views of 1½ inches square to be obtained at very short intervals. The task of constructing an automatic camera with at most 2 inches focal distance, the weight of which, including all accessories, must not exceed 2½ ounces (the maximum load readily transported by carrier pigeons) evidently was by no means an easy one.

One type of apparatus comprises two self-contained cameras with lenses pointing forward and backward respectively, so as to obtain at least one view of the ground in any position of the pigeon. The two cameras are fitted in a light frame of aluminium, attached by straps and rubber bands to the body of the bird. The shutter is released by a spoon-shaped lever, the cavity of which is thrown outward by a rubber ball filled with air and perforated by a minute opening. As the air escapes, the rubber ball collapses, permitting the lever to disengage the shutter. In the case of another form of apparatus a single lens is used in connection with a film, on which a number of successive exposures are made by a rubber ball and clock mechanism at given intervals of, say, one-half minute.

As a carrier pigeon, after starting, at first describes a spiral line, it is quite easy to take a number of views of a given portion of the ground from different points of view. After once determining the position of its cote (which it recognizes from a distance of upward of 20 miles) the pigeon flies toward its goal in a straight line and at the uniform speed of an express train, so that the route to be recorded photographically can be readily determined in advance.

Photographer pigeons are likely to prove useful primarily for strategical purposes. From besieged places, they allow the positions of the beleaguerers to be ascertained, while the latter in a similar manner can obtain information as to the topography of the besieged. Dr. Neubronner has devised for this special purpose transportable dove cotes mounted on a lazy tongs mechanism, whereby they may be raised to afford a suitable launching point for the pigeons. The German military authorities have shown much interest in this matter, inviting the inventor to conduct some experiments in conjunction with the balloon corps at Tegel, near Berlin. Photographer pigeons are likely to be used also in connection with dirigible airships, permitting the latter to remain at a safe distance from the ground, while the pigeons when released will fly near enough to take any photographic views desired.

Portable cote and room.

A 2½-ounce apparatus for taking eight pictures.

The Scientific American in 1909.

The Editor of the SCIENTIFIC AMERICAN hopes to make the journal even more interesting, if possible, during the year 1909 than it has been in the past. Among the new features will be a series of articles on famous living American inventors, men who have contributed to the upbuilding of our giant industries. It will be the object to give not only a verbal impression of these inventors as men, but to show in dollars and cents just what they have accomplished by sheer inventive ingenuity. Among the men who will be discussed are Thomas A. Edison, Alexander Graham Bell, James Gayley, John Patterson, and others equally famous.

The Handy Man's Workshop, the new department which was started a few weeks ago, has proved so popular that the Editor will strengthen it, and publish it at frequent intervals during the year.

More than the usual number of astronomical articles will appear during the coming year, because we find that our readers are more than interested in the subject. One of these articles will deal with the remarkable phenomena of the Morehouse comet, which has proved so puzzling to astrophysicists.

Among the special issues to be published one will be devoted to western engineering, in which the government's wonderful work in reclaiming arid lands by irrigation will be fully discussed by able engineers, and likewise the engineering development of Chicago.

The Junior Aero Club Exhibit at Madison Square Garden.

The Junior Aero Club, which was organized about a year ago by Miss E. L. Todd, gave its first exhibition at the Toy Show in Madison Square Garden, during Christmas week. The exhibit was a creditable one and showed a great deal of interest on the part of the boys who compose this society. The club has forty members, scattered over the country, and it is, therefore, largely a correspondence organization. The boys get their ideas from studying the magazines and aeronautic papers. In the recent exhibition there were two model dirigible balloons and nearly a dozen model aeroplanes constructed by them. The latter varied in size from 2 or 3 feet to 7 feet in length. Most of them were fitted with propellers having rubber bands as motive power. The largest model, that made by Percy Pierce, was constructed on the lines of the "June Bug" aeroplane, but it had two propellers running in opposite directions, such as are used on the Wright machine. The same boy exhibited a 15-foot gliding machine of the standard Chanute pattern. The workmanship on both the model and the glider was excellent.

Another interesting model was constructed on the Langley type by Walter B. Phipps, the son of a well-known electrical engineer. This model was provided with a keel running lengthwise below the two following surfaces. It is interesting to note that something of this sort was suggested recently by Octave Chanute, while the same idea was thought of by this twelve-year-old boy.

One of the most complete Wright-type models was fitted with a half-horse-power steam engine and flash boiler, the whole power plant weighing but 2½ pounds. The model was built by Walter Wittman, and the engine by his elder brother. This machine, it is believed, will make a much longer flight than the models propelled by rubber bands.

There were a number of other interesting exhibits in the shape of odd kites, one of which, constructed by the late Henry Rodemeyer, had a peculiar bird-like shape. There were also two tetrahedral cell kites, one of which was furnished by Dr. Bell, and the other of which was constructed by one of the boys. A wireless telegraph apparatus constructed and operated by boys was also exhibited. This apparatus was designed by W. E. D. Stokes, a twelve-year-old boy, who has a 5-kilowatt long-distance wireless station on top of the Ansonia Apartments in New York city.

The exhibit was completed by some excellent photographs showing the chief dirigible balloons and aeroplanes. There were also a number of drawings of aeroplanes submitted by members of the club. The noticeable thing about these designs was that there were few of them freakish, but that they all followed the lines of standard machines. There was also a full-sized foot-propelled wind wagon and several small spring-driven models of this form of propeller-testing machine.

Wernecke has patented a continuous automatic filter press divided into several compartments, which are arranged radially about a horizontal axis, forming a polyhedral box. The outer end of each compartment is closed by a hinged and grooved plate covered with filter cloth. The inner end is of similar construction, and can be forced outward by a lever. The compartments are filled through pipes connected with one end of the hollow axis, and emptied through pipes connected with the other end. The operations of filling, pressing, and emptying are performed automatically as the apparatus is rotated. As each compartment arrives at its lowest position the outer end is opened and the press cake is expelled.

Portable, collapsible cote for military use.

Carrier pigeon equipped with a two-lens camera.

Magnified picture taken by a carrier pigeon.

A NOVEL USE FOR CARRIER PIGEONS.

MOVING PICTURES THAT SING AND TALK.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

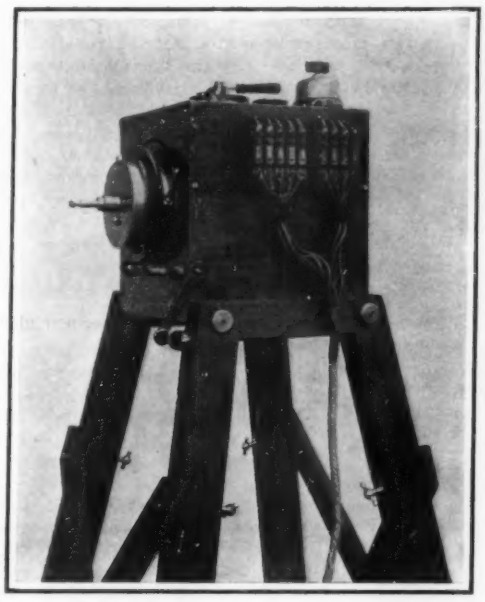
In view of the success which is obtained by the moving picture apparatus, the idea naturally occurred to use the phonograph in connection with it, so as to hear the voice at the same time that we see the picture upon the screen. Among such devices we may mention one brought out by Pathé. It is the invention of Capt. Couade. In his method, the actor utters the words or song into the phonograph, but without the gestures or facial expression.

The actor takes his position before the camera and his movements are photographed. Coupled with the moving picture machine is the phonograph of the flat disk type which was before used. A jointed rod coupling is used in order to connect the phonograph mechanism with the picture machine, and the latter is driven by a small electric motor. While the phonograph is repeating the actor's words, he goes through the necessary motions to accompany the words. The moving picture machine thus secures the photographic record of the series of gestures during the whole time that the phonograph disk is working.

In reproducing the two records at exactly the same rate of movement, the moving picture machine is placed as usual at a point behind the audience at the back of the hall, while the phonograph is located near the screen. The weight-driven mechanism of the phonograph is coupled to a revolving electric device which serves to produce a current, and this current is sent to the moving picture machine. In the latter there is mounted an electric motor, which drives the machine. As this motor receives current from the electric device on the phonograph, its speed is exactly the same as that of the phonograph. By this means we have a perfect concordance between the two apparatus.

Capt. Couade seems to have solved the problem of working the two machines in harmony. Both apparatus start up simultaneously and afterward run at the same speed, by simply placing the phonograph needle on a marked point of the disk and on the other hand using a marked image of the picture film at the same time. These points were previously obtained when the phonograph and picture machine were directly coupled by the shaft as above mentioned.

Capt. Couade's invention consists in the use of a revolving device which is driven by the weight mechanism of the phonograph. The device resembles a revolving commutator, and it receives direct current from the city mains and transforms it into alternating current. The motor is mounted in connection with the moving picture machine, and it consists of a simple two-pole electric motor which is arranged to run upon the three-phase current. Such a motor takes exactly the same speed as the driving mechanism of the phonograph.



The motor in its portable case. The handle serves to operate the differential so as to keep the phonograph and moving picture apparatus in step.

The phonograph repeats the previously recorded utterances of the actor while he performs the necessary gestures in synchronism for the moving picture machine.

Weight-driven phonograph used to send a current into the distant moving-picture machine motor.

MOVING PICTURES THAT SING AND TALK.

Motorless Aeroplanes.

Is it possible to soar in the air for an indefinite time without motive power? Deprez in the SCIENTIFIC AMERICAN SUPPLEMENT has shown how the soaring flight of certain birds can be explained by the pressure of the air on the various parts of their bodies, provided that the surrounding air possesses some velocity in an upward direction. No such continuous upward flow of air has been detected by meteorological observations. In a paper recently presented to the French Academy of Sciences, Esclangon dispenses with the upward flow and shows that every variation of the velocity of the wind, in magnitude or direction, from its mean horizontal velocity may, in theory, be utilized as a motive power by a soaring bird or an aeroplane. Every such variation increases the total energy of the system composed of the aeroplane and the surrounding air, and every such increase in energy can be transformed either into the kinetic energy of speed or into the potential energy of elevation. In order to reduce to a minimum the power required to propel an aeroplane, it will be necessary, first, to learn how to convert speed into elevation, and conversely, with little loss of energy, and secondly, to devise aeroplanes which, like birds, shall be able to adapt themselves instantly to changed conditions, so as to utilize the incessant fluctuations of the wind. The practical solution of the latter problem will undoubtedly present great difficulties.

Moving Pictures in Colors.

After the successful solution of the problem of color photography by the Lumière brothers, the problem of color chronophotography seemed to be nearing its final solution. But the practical difficulties encountered were far greater than in ordinary photography. Flexible films of 100 feet and more in length must be handled instead of glass plates of limited size. On the other hand the Lumière process is suitable only for the making of transparencies. Duplicate positives from a series of negatives are out of the question.

A novel system has recently been invented by a Roman painter, Signor Barricelli, for the cinematographic reproduction of animated scenes in their natural colors. The coloring of the films is obtained by means of the three-color process, but in a novel way. Instead of coloring the film itself, the inventor reaches his result by a rapid presentation of images, each of which is colored in one of the three fundamental colors (red, yellow, blue). By virtue of the well-known phenomenon of visual persistence, these images will give the impression of a complete three-color image.

In order to reproduce a given scene in its natural colors, it is sufficient to photograph the object three times through properly colored screens, each of which will allow only the light rays of a given color to pass. Thus three analytical color negatives are obtained. The corresponding positives printed from these negatives in black and white must be projected in rapid succession on a white wall, each through the same color screen used in obtaining the negative. The eye will then perceive a multi-colored image, provided the rate of succession be such that the individual impressions due to the various colors on the retina may superpose themselves on one another. The length of the photographic film as well as the speed of succession should accordingly be three times as great as in an ordinary cinematograph. The system adopted by Barricelli for insuring the succession of the various color screens in front of the objective, both during the taking of the views and during projection, is of remarkable simplicity. A glass disk divided into three colored sectors according to the fundamental colors, red, yellow, blue, is rotated in front of the objective so as to change the screen at each move of the cinematograph shutter.

RETROSPECT OF THE YEAR 1908.

(*Continued from page 3.*)

daily, running on schedule speeds of from fifty-five to sixty miles an hour. At the same time, it should be borne in mind that there are no trains in the world that can compare in long-distance, high-speed runs with our eighteen-hour trains between New York and Chicago.

Electricity.

Unquestionably the most important work at the present time in the field of electricity is its substitution for steam locomotives in the operation of railroads; and of the many changes of this character which have recently been made, the most important are those on the New York Central and the New Haven railroads in this country. In respect of the great density of the traffic on these four-track systems, the conditions for electrification are highly favorable; but because of the many track complications involved at the terminal yards and stations, the work of installment and operation has been perplexing and difficult. The operation of the New York Central electric zone has been carried on through the year with the same smoothness and regularity which have marked this highly successful work from the very day of its opening. Save for the one disastrous accident at Woodlawn, which was due, in our opinion, to gross carelessness in operation, there have been no serious accidents attributable to the electrical equipment, and the number of delays has been less, we understand, than in the days of steam service. The attention of the electrical world has been focused more particularly, however, on the New Haven equipment, for the reason that here, for the first time, the experiment (and it was surely nothing more nor less than a gigantic experiment) was made of equipping a four-track road carrying an exceedingly dense traffic with a high-pressure monophase system with overhead conductors. Toward the close of the year a remarkably candid and very detailed paper was read by the chief electrical engineer of the road, giving a history of the many obstacles encountered, and the way in which they have at last been successfully overcome. Serious troubles developed in the generators, in the line, and in the motors. Apparently these have been thoroughly mastered, and for some six months past the system has been running with a regularity which involves, according to the officials of the road, fewer delays than occurred in the days of steam service. What the technical world is waiting for, however, is the publication by the New York Central and the New Haven systems of the first cost and of the cost of operation of their respective plants. When these are available it will be possible to arrive at a pretty accurate estimate of the relative efficiency, under these particular conditions, of the single-phase and the direct-current systems. The present indications are that the direct-current is ideal for suburban and terminal roads, and the monophase system for long-distance lines outside of the suburban zone. Hence, we are not surprised to learn that the Pennsylvania Railroad Company has decided to use the direct-current on its tunnel zone from Long Island City to Harrison, N. J., with the probability that the alternating current will be adopted when the electrification is extended to Philadelphia. A contract for the electrification of the tunnel zone has recently

been let for $5,000,000. Next in importance to the work being done in this country is the electrification of certain of the Prussian railroads, one the Magdeburg-Hitterfeld-Leipsic line, 80 miles in length, and another the Leipsic-Halle line, 22½ miles in length.

As far as any material progress is concerned, wireless telegraphy stands at the close about where it stood at the beginning of the year under review. Attention has been directed rather to the improvement of mechanical details in the way of wave-detectors, transmitting keys, and the other mechanical features, than to the solution of the larger problems of selective synchronism and reliable long-distance transmission. All the wireless companies are endeavoring to perfect a selective system, but apparently they are no closer to the goal than they were four years ago. Any small boy armed with a Ruhmkorff coil is an *enfante terrible* in the path of a wireless message. The most satisfactory results have been obtained in the coasting trade and in naval operations, where messages may be transmitted with considerable certainty within the limits of 100 or 150 miles. But when it comes to a matter of transmission for distances of 1,000 miles or over, the maintenance of uninterrupted service is at present out of the question. Under exceptionally favorable atmospheric conditions, messages have been transmitted across the Atlantic and from the New York navy yard to Panama; but the connection is liable to sudden and complete interruption from causes which at present are purely problematical. Marconi, Fessenden, Professor Fleming, and others attribute the breakdown to what, for want of a better name, they call "atmospheric absorption." Conditions in the field of long-distance wireless telegraphy are such that it is safe to say that this field is not by any means ripe for commercial exploitation. The same may be said of wireless telephony, which, although it shows great promise for the future, has not as yet been placed on a practical commercial basis. Limitations of space prevent anything more than the mere mention of the great ingenuity shown in the transmission of writing by means of the telautograph and the transmission of pictures by Knudsen's ingenious process. For a detailed explanation of these the reader is referred to our issues of June 6 and November 21 of the past year.

Astronomy, Chemistry, and Physics.

Astronomically, the year has brought forth the usual number of celestial events. There were three solar eclipses, none of which was of much importance. Solar eclipses in such number occur only once in nine years, which is the only reason why the 1908 eclipses are here mentioned. At Greenwich Melotte discovered a faint body, which was at first taken for an asteroid, but which later proved to be an eighth satellite of Jupiter. Encke's comet, the more carefully studied of the periodic comets, duly returned. More remarkable than this body of Encke's was the comet discovered by Prof. Morehouse on September 1—remarkable because of its peculiar tail distortions and fluctuations. These tail phenomena will be discussed in a forthcoming issue of the Scientific American. Prof. Trowbridge, who has been conducting a series of important experiments, announced that gas phosphorescence and meteor trains have much in common. From this it would follow that the after-glow produced in the sky by meteors is merely a phosphorescent phenomenon.

Prof. Onnes's achievement in liquefying helium after many futile attempts must be hailed as a wonderful technical triumph. Although the most refractory gas has at last been conquered, the liquefaction of helium cannot be said to add very much to the sum total of our chemical knowledge.

The radio-active substances still command a prominent place in physical research. Perhaps the most dramatic event of the year was Madame Curie's announcement that, after careful experimentation conducted by herself and Mlle. Gleditsch, she failed to confirm Ramsay's assertion that radium emanation possesses the singular property of degrading copper to lithium. This leaves the whole question very much in the air. A third checking of the experiment is obviously necessary. If Boltwood's work is correct, ionium may be regarded as the true intermediate product between what is known as uranium X and radium, which gives no fewer than twenty-four new elements discovered by radio-active methods. Ramsay has presented evidence that the emanations of thorium and radium should be classed with such inert gases as argon. C. E. S. Phillips claims to have discovered radio-active powers in freshly cut sodium. The evidence (the discharging effect of the metal) is strong, but not strong enough to warrant us in believing that he has completely established his discovery.

Dr. Bechtold has devised what he calls a system of "ultra filtration," which has enabled him to separate dissolved substances from their solvents by the use of excessively fine filters consisting of paper or fabric impregnated with gelatine. This system actually carries the chemist within the region of molecular dimensions.

Aeronautics.

In tracing the development of aeronautics the historian of the future will point to the year 1908 as that in which the problem of mechanical flight was first fully mastered; and it must always be a matter of patriotic pride to know that it was two typical American inventors who gave to the world its first practical flying machine. To a natural mechanical aptitude the Wright brothers added a perseverance, a resourcefulness, and a daring, which have enabled them, at last, to realize this dream of the ages. In April of this year, the brothers went down to the sand dunes at Kitty Hawk and tried out their machine, preparatory to subjecting it to public test. On September 10, at Fort Myer, Orville Wright flew continuously for 1 hour, 5 minutes and 52 seconds, and subsequently made three other flights of over an hour. Finally, in making a flight with Lieut. Selfridge as a passenger, he was thrown to the ground, through the breaking of a propeller, Lieut. Selfridge being killed and he himself seriously injured. On September 21 Wilbur Wright, in France, made a continuous flight of 1 hour and 31 minutes; and, after three months of most brilliant work achieved the remarkable feat of flying continuously for 1 hour, 53 minutes, and 59 seconds, thereby winning the Michelin prize of $4000 and a trophy. In his flight he covered 61½ miles of distance at a speed of 36 miles an hour. Both of the brothers have proved their ability to carry an additional passenger. By his success in France Wilbur Wright effected the sale of his French patents for $100,000. Next in importance has been the work of Farman who, on October 30, made a straight-away cross country flight of 17 miles from Chalons to Reims at a speed of over 51 miles an hour. Of equal, if not greater merit, was the trip of Bleriot with his monoplane when he flew from Toury to Artenay and back, a distance of 17.38 miles, at an average speed of 53.78 miles an hour. For comparison with the long-distance flights above recorded, the following achievements will be of interest. On September 14 Santos-Dumont with a monoplane made a continuous flight of 8 minutes. On September 17 Delagrange with a two-surface machine flew for 30 minutes, 27 seconds. On October 31 Bleriot, with a monoplane, in his cross country flight, was in the air continuously for 11 minutes. Farman, on October 2, in competing for the Michelin prize, won by the Wright brothers, remained in the air for 44 minutes, 32 seconds. On August 21 a G. M. monoplane flew in a circle 1½ minutes, and on July 22, Breguet, in a gyroplane—a combined helicopter and aeroplane—made a flight of 20 meters distance. It has been estimated that the total duration of Wilbur Wright's seventy-two flights in France, up to October 15, amounted to 13 hours, 49 minutes; and that thirty persons have been carried a total distance of 431 miles, without accident. In the presence of such figures it cannot be disputed that mechanical flight is no longer an experimental proposition. In spite of the success of the Wright brothers, it looks as though Europe would be the developing ground for the aeroplane and dirigible, as it has been for the automobile. Proof of this is seen in the fact that cash prizes to the total of $350,000 have been offered in Europe for aeronautic contests of various kinds. In America the only prize offered for competition is the Scientific American trophy, which was won for the first time by Glenn H. Curtis on July 4 in a flight of over a mile in a straight line, made with a two-surface aeroplane, built by the Aerial Experiment Association. The speed was nearly 40 miles an hour. The machine carried a tail similar to that used on the Farman aeroplane, and was driven by a 25-horse-power air cooled engine. The same association has built a later machine, which is driven by a 40-horse-power, water-cooled engine. It has no tail, and, like the earlier machine, is characterized by a transverse arching in opposite directions of the two main surfaces.

No less striking have been the achievements of the various large dirigible airships. Conspicuous among these are the long-distance flights of Count Zeppelin with his huge but ill-fated craft, known as "Zeppelin IV." On the 29th of June he was in the air for six and three-quarters hours. On the second of July he made his first long cross-country trip to Luzerne, covering 248 miles in 12 hours at a maximum speed of 34 miles per hour. On August 4 he made his great attempt at a 500-mile 24-hour trip. He landed at Oppenheim after covering 260 miles in 9 hours; then passed over Mayence; returned to Stuttgart, and made a successful landing at Echterdingen, where his machine was destroyed by a thunderstorm. The Germans have three new military airships, the "Gross II," "Parseval II," and the reconstructed "Zeppelin III." France has "La Republique," the "Ville de Paris," and the old "Lebaudy." The giant Zeppelin airship was about 440 feet in length; the German and French dirigibles are generally a little less than 200 feet in length, and the approximate speed, under normal conditions, may be set down at about 30 miles an hour. In connection with the trials at Fort Myer, it should be mentioned that the small dirigible built by Baldwin, capable of carrying two men and of remaining in the air for two hours continuously, passed successfully its acceptance tests by the United States army.

Automobile and Motor Boat.

That the automobile has practically reached the limit of its development is suggested by the fact that during the past year no improvements of a radical character have been introduced. The six-cylinder machine grows slowly in favor; but there is no indication that it will become the prevailing type. There has been a great increase in popularity of the moderate-priced, medium-sized car, of 24 to 30 horse-power, and costing from $1,200 to $1,800. There is cause for congratulation in the fact that both in racing and touring cars the later American models show a decided improvement in durability; and it can be said without much fear of contradiction that the output of the leading builders of this country is at last fully comparable to the best of the foreign makes. The Glidden tour, that supreme test of reliability, bears out the truth of the above statement. It was run this year over a 1,700-mile course, through Buffalo, Pittsburg, New York, Albany, Maine, the White Mountains, and Saratoga. Although the conditions of the whole trip were exceedingly trying, the machines made an average speed of 20 miles an hour, and this in spite of the fact that no repairs were allowed in the garages. Of the forty-five machines that started twenty-eight finished with a perfect score, nine of them making up three three-car teams, fourteen others being touring cars, and five runabouts.

The two great races of the year—the Vanderbilt and the Grand Prize—were held successfully over courses on Long Island and at Savannah. The Vanderbilt cup race was won by the 1906 Locomobile racer of 120 horse-power, at an average speed of 64.39 miles an hour. Second place was taken by the Italian Isotta, which maintained an average speed of 63.7 miles per hour. The Grand Prize race over the 402-mile Savannah course was won by an Italian Fiat car of about 110 horse-power, at an average speed of 65.1 miles per hour, the second car being a German Benz, which was beaten by only 56 seconds. Over the same course the light stock car race was won by an Italian Lancia car, at an average speed of 52.6 miles per hour, an American Buick car being second. That these light cars with only about one-fourth the power of the racing machines should have made such good speed is highly creditable.

The motor boat racing of the year was signalized by the victory of the American "Dixie II" in the race for the Harmsworth international trophy, held on August 3 on Long Island Sound. The challengers were the British "Wolseley-Siddeley" of 400 horse-power, and the "Daimler II" of over 500 horse-power; and, to meet them, the Crane brothers designed the "Dixie," a beautifully-turned boat provided with but 200 horse-power. The "Daimler II" broke down, the "Wolseley-Siddeley" covered the course at a speed of 27.34 knots, and the "Dixie" at a speed of 27.71 knots, the American boat winning the race by a close margin of 49 seconds. A day or two later the "Dixie" in four runs over the government measured mile averaged 31.05 knots, thus establishing her claim to being the fastest motor boat in the world.

The Current Supplement.

Sir J. J. Thomson's brilliant paper on "Rays of Positive Electricity" is by far the most important contribution to the current Supplement, No. 1722. Major Squier gives his views of the possibilities of aerial locomotion in warfare. Day Allen Willey describes a concrete coal-mine shaft. How roads are tarred is explained by Prevost Hubbard. The usual notes will be found in their accustomed places. Sir Oliver Lodge gives a simple explanation of the theory of electrons. The action of radium emanation on distilled water is discussed by Sir William Ramsay, the distinguished English chemist.

A $500 Prize for a Simple Explanation of the Fourth Dimension.

A friend of the Scientific American, who desires to remain unknown, has paid into the hands of the publishers the sum of $500, which is to be awarded as a prize for the best popular explanation of the Fourth Dimension, the object being to set forth in an essay the meaning of the term so that the ordinary lay reader can understand it.

Competitors for the prize must comply with the conditions set forth in the Scientific American of December 26, 1908.

A clear solution of shellac in alcohol, with an addition of picric acid and 1 per cent of boracic acid, makes a gold varnish that produces a fine hard surface and brilliant finish on metals.

THE HEAVENS IN JANUARY.

BY HENRY NORRIS RUSSELL, PH.D.

THE finest group of constellations in the whole heavens is that which now occupies the southeastern skies.

Its central figure is Orion, which is about half way up to the zenith. The principal stars of this noble constellation can easily be identified with the aid of our map; while the initial letter at the head of this article shows how these stars are related to the traditional figure of the classic giant. The bright stars Betelgeuse and Rigel are in his shoulder and at his foot, while it is easy to trace his belt, his sword, the uplifted club in his right hand, and the lion's skin which he holds as a shield in his left.

Above Orion is Taurus, with the small but conspicuous cluster of the Pleiades. The V-shaped group below them, of which the bright red star Aldebaran is one, bears the name of the Hyades. The star between Aldebaran and the point of the V is a fine naked-eye double.

Below Orion is Canis Major, whose brightest star, Sirius, so far outshines all its neighbors (and indeed all others in the sky) that it is hard to realize that several of them are fully as bright as the stars of Orion's belt. To the left of these constellations are three almost equally fine ones—Auriga, Gemini, and Canis Minor—which contain four more stars of the first magnitude.

Due east is Cancer, marked only by the small star cluster Praesepe, and on the horizon are part of Leo, and the head of Hydra. Jupiter is in the former constellation, and will rise within an hour.

Below Orion are the small groups of Lepus and Columba, and west of these is the long faint star-stream of Eridanus, beyond which is Cetus, in the southwest. The variable Mira is now fading, and barely if at all visible to the naked eye.

The great square of Pegasus stands on one corner, low down and almost due west. Above it Andromeda extends toward Perseus, which is directly overhead. Aries and Pisces lie south of these.

Cygnus is setting in the northwest, Draco and Ursa Minor are below the pole, Ursa Major rising in the northeast and Cassiopeia and Cepheus high up in the north-northwest.

When we look at such clusters of stars as the Pleiades or the more widely scattered Hyades, the question naturally arises: Are these stars really near one another (as compared with their distance from us); or do they simply look near, because they lie nearly in line with us, though some are really more remote than others?

We cannot answer this question by direct measurement of their distances, for these are so great that it is not yet possible to measure them accurately enough for our purpose. But we can get an answer in another way.

How it is done can perhaps best be explained by an illustration. Suppose the air was full of birds of all sizes at all sorts of distances, flying in every direction at various rates. Two or more birds that at a given instant seemed near together would do so only because they were in line and their flights, being in different directions, would soon carry them far apart. But suppose that among them there was a flock of wild geese. We could tell at once that these birds were really near one another, because they kept together, flying in parallel lines. If we watched them longer, the flock as it came nearer would appear to spread out and grow larger, until it passed overhead, and then to dwindle again in the distance; but all the while any chance bird that passed before or behind it could be identified by its different direction of flight.

Now each of these groups of stars—the Pleiades and Hyades—behaves exactly like such a flock of birds. The stars in general move over the sky, some faster, some slower, but in directions that vary almost at random from star to star; but the stars of each of these groups keep together, in a way which proves their real connection.

And this is not all. Prof. Boss, who has recently supervised the preparation of a great catalogue of stars for the Carnegie Institution, in which their motions are very accurately determined, has identified nearly forty stars (most of which are visible to the naked eye) belonging to the Hyades group, and has shown that their motions are not exactly parallel, but converge toward a point in the constellation Monoceros between Betelgeuse and Procyon. That is, this group of stars, if we could watch them long enough, would seem to shrink together. It follows that these stars are receding from us, having already long passed their closest approach—about 700,000 years ago, as the present rate of motion shows.

Confirmation of this remarkable result is furnished by observations with the spectroscope, which show that three of the brightest stars of this group are actually receding from us, all at the same rate—25 miles per second.

That not only agrees with Prof. Boss's theory, but enables him to calculate the dictances of the stars of the group from us, which average about 120 light-years, with a range of about 10 per cent on each side of the mean.

At this distance our sun would appear as a telescopic star of the eighth magnitude, and therefore the brightest stars of the Hyades must be much brighter than the sun—probably between 50 and 100 times as bright.

The brightest of all the cluster (as we see it), Aldebaran, is however an intruder, moving in quite a different direction. Its distance has been directly measured and appears to be about 30 light years—only one-quarter that of the great cluster. If removed to their distance it would seem three magnitudes fainter than it does now and be no brighter than several other stars of the cluster.

THE PLANETS.

Mercury is evening star all through the month, and is well visible during the latter part of it. On the 26th he reaches his greatest elongation (or apparent distance from the sun). At this time he sets about 6:35 P. M. and can easily be seen, low in the southwest, when it begins to grow dark. Venus is morning star and rises about 5:40 A. M. in the middle of the month. Mars is likewise morning star, rising about two hours before Venus. On the 13th he is quite close to the bright star β Scorpii.

Jupiter is in Leo and rises about 9 P. M. in the middle of the month. Saturn is evening star in Pisces, setting about 11:30 P. M. on the 1st, and 9:45 on the 31st.

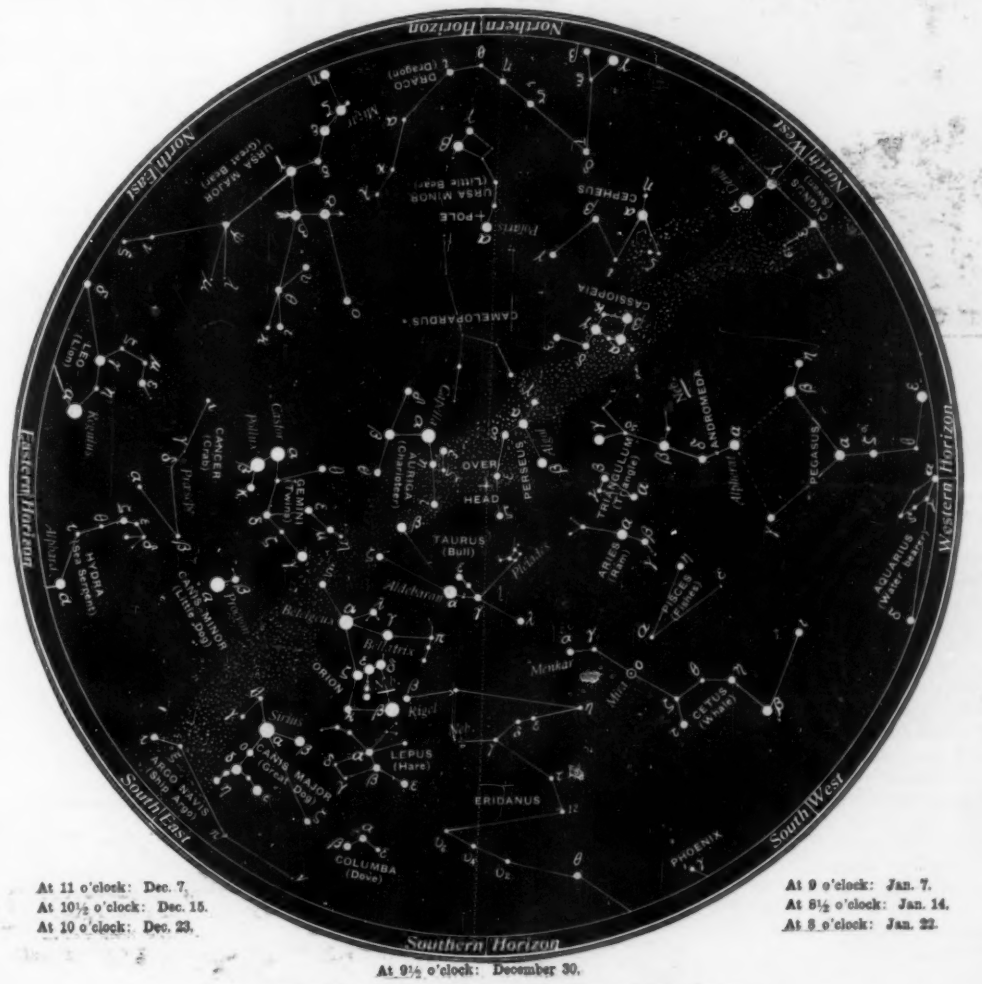
Uranus is in conjunction with the sun on the 7th and is invisible throughout the month.

Neptune is in opposition on the 5th. At this time he is in R. A. 7h. 8m. 58s. Declination 21 deg. 45 min. north, and is moving 7s. eastward and 12s. northward per day. To see his disk requires a good-sized telescope.

THE MOON.

Full moon occurs at 9 A. M. on the 6th, last quarter at 1 P. M. on the 14th, new moon at 7 P. M. on the 21st, and first quarter at 10 A. M. on the 28th. The moon is nearest us on the 23d and most remote on the 11th. She is in conjunction with Neptune on the 6th, Jupiter on the 11th, Mars on the 17th, Venus on the 19th, Uranus on the 20th, Mercury on the 22d, and Saturn on the 25th.

Princeton University Observatory.



At 11 o'clock: Dec. 7.
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.

At 9 o'clock: Jan. 7.
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan. 22.

At 9½ o'clock: December 30.

NIGHT SKY: DECEMBER AND JANUARY

Origin of Gold Deposits.

The current theory of the formation of gold-bearing alluvial deposits assumes that the gold existed originally in the central nucleus of the earth in the forms of sulphide and telluride, which subsequently became dissolved in the waters of hot springs and were deposited together with gelatinous silica. Thus were formed veins of auriferous quartz which, in consequence of erosion, gave rise to alluvial strata containing particles of metallic gold.

M. Fieux, however, asserts that the erosion of outcropping auriferous veins of quartz does not account for all deposits of metallic gold. He finds that some gold-bearing strata show no trace of quartz, but consist wholly of clay with fragments of diorite or diabase, and moreover are so situated as to preclude the existence of quartz veins. He has seen beds of streams become richer in gold after every rain, though they showed no trace of quartz. Finally, in certain auriferous strata which contain much quartz, not a particle of gold is found in the quartz, though some gold occurs in the diabase which accompanies it.

Hence Fieux concludes that the erosion of quartz veins cannot be the sole source of auriferous alluvial strata and, furthermore, that the almost constant presence, in those strata, of heavy basic rocks, containing diorite, amphibolic schist, and diabase, indicates that native gold is one of the subsidiary ingredients of those rocks.

According to this new theory, therefore, certain of the heavy eruptive rocks have carried with them in their eruption some of the gold existing in the metallic state in the central nucleus of the earth. After reaching the surface these rocks were oxidized by contact with the air and eroded by water, which washed away the lighter materials and left the heavier, including the gold.

This M. Fieux regards as the true theory of the formation of gold-bearing alluvial strata, in general, the erosion of quartz veins being only an occasional cause of the enrichment of those strata.

Handy Man's Workshop.

Next week's issue of the SCIENTIFIC AMERICAN will contain a special Handy Man's Workshop Department devoted to winter sports. There will be complete directions for making an iceboat, also a thoroughly practical article on the building of a "scooter" or ice-and-water sailboat. Hand-motor sleds and coasting skates will be other features of the department. The constructions described will be simple and calculated not to overtax the ability or purse of the average amateur.

TIDAL-WAVE MAKING ON THE STAGE.

A sensational theatrical spectacle is being produced at the London "Hippodrome" under the title of "The Sands of Dee," of which the pinnacle is the breaking of a series of nine huge tidal waves across the stage.

The wave scene as the spectators see it. Photo by Campbell-Gray.

The rollers wash with terrific force, sending the spray some thirty feet into the air with a long muffled roar.

The stage extends forward of the proscenium arch in the form of an arena, the seating accommodation being disposed circularly around this projection. The general setting may be gathered from the accompanying illustration, a typical seaside resort in the height of the season being represented. The stage and arena constitute a stretch of the rock-strewn sands exposed by the receding tide depicted on the backcloth. In the center of the stage is a crude notice warning the visitor of the time when the tide will turn.

In the culminating point of the dramatic storm, the heroine is gagged and bound to the tide-warning board, to be drowned by the rising tide. At the crucial moment the first wave breaks over the scene, catching the escaping villain in its embrace. Eight succeeding waves sweep all before them. The heroine is of course duly rescued by the hero just when the water has reached her shoulders. Her rescuer reaches her on the back of a swimming horse. The whole incident lasts about ninety seconds, in which short interval no less than forty-five tons of water are projected into the arena. No sign of the water is seen by the spectators until the first wave is actually breaking.

The means by which the waves are produced however is very simple, though it involved prolonged experiments for the purpose of evolving what may be termed a perfect wave, which should be as similar to a real ocean breaker as possible. Behind the backcloth up in the flies, seventy-nine feet above the stage, are carried three large rectangular water tanks of special design. They are built of teakwood, strongly bound with iron, heavily lined with lead, to prevent leakage, and supported on steel girders. These tanks are fed from a high-pressure main, the arrangement being such that although the contents of the tank may be discharged solidly, the tank may refill in two or three seconds.

The outlet from the tank has an area approximately one-third of the floor area of the tank. The tank may be emptied just as if its whole bottom were suddenly removed. When closed the mouth of this outlet resembles an inverted apex built upon a lever system, with the result that when outside pressure is applied upon the levers, the closed members forming the apex swing instantly open to their full extremity.

Immediately beneath the outlet from the overhead tanks upon the stage is built what is called a "wave-producing board." This is mounted about one foot above the level of the stage, and is of the most substantial construction, in order to withstand the tremendous vibration arising from the fall of five tons of water at a time from a height of seventy-nine feet. It is of concave form, and extends from side to side of the stage, so as to command the whole of the proscenium opening. The rear face of this receiver or conduit is carried up to a height of ten feet or so, while the front edge is only about one foot above the extreme depth of the concavity. The falling water does not strike the center of the channel, but the inner curved face of the back edge, so that it swirls round the bottom of the channel and up the opposite face unresisted. It shoots into the air across the stage to a height of thirty feet, and falls into the arena a tumbling mass of water.

The backcloth is placed in front of this wave-forming board, so as to conceal the falling water. The lower edge of the backcloth ends a few inches above the upper edge of the rear face of the wave-forming board, and hangs practically in a line with the front edge of the board. The backcloth depicts a sea scene. That part of the inner face of the wave-forming board which would consequently be visible to the audience is embellished with waves executed in waterproof paint, so that the backcloth appears to fall continuously from top to bottom of the stage. When the water, in falling, swirls around the wave-forming board and is impelled on to the stage, it passes beneath the lower edge of the backcloth in a solid sheet. It was in the correct design of this wave-producing board that the greatest difficulty was experienced. The prime object sought after was the projection of a solid roll of water over the stage without any splashing until it breaks in the same manner as an ocean wave. At the same time it was imperative that the course of the water should be to a certain extent directed in its path, so as to save the stage and wings from inundation. As it is, the whole of the water is thrown into the arena.

Scarcely has the first wave broken, when the second rolls out, followed by successive breakers, until the full nine in all have traveled across the arena. About five or six seconds elapse between each wave. When viewed from the center of the auditorium, a very realistic impression of a series of rollers breaking and falling tumultuously over one another is presented. Each wave contains a solid mass of five tons of water, making forty-five tons in all thrown through the proscenium opening at a total cost of over $500 for the water alone. The falling mass, as might naturally be supposed, strikes the wave-forming board with tremendous force, and retains considerable power in its sweep across the stage, rendering the task of the villain, who is caught in its toils, to maintain his footing upon the rocks no easy matter. The crash attending the falling water striking the forming board suffices to produce the muffled roar accompanying rollers breaking upon the seashore.

In order that the stagecloth behind which the water falls may remain absolutely quiescent and steady throughout the whole operation, it is specially weighted to over one and a quarter tons, requiring special mechanism for its operation alone. The water filling the arena is subsequently released and escapes into the public sewers, so that a fresh supply is used in each performance.

The scene before the "tide turns." Photo by Campbell-Gray.

THE GREAT WAVE SCENE AT THE LONDON HIPPODROME.

Method of Removing Fixed Stoppers.

BY RANDOLPH BOLLING.

Reagent bottles holding caustic alkalies, alkaline carbonates, etc., very frequently become fixed, and the usual method has been to tap the stopper with a wooden block, or the application of heat to the neck, or a combination of both. Results are poor in certain cases and often result in the fracture of the neck. The inverse process may be used to advantage. In other words, freeze the stopper, thus causing a contraction of the stopper from the neck. The bottles which I used for experiment had failed to open, under the heating and tapping, and were bad cases of fixed stoppers. The bottles held sodium carbonate, that had formed sodium silicate, an excellent cement, and so were firmly fixed. They were inverted in a mixture of crushed ice and calcium chloride, taking care that the freezing solution did not touch the lips of the bottles. After standing twenty minutes, each stopper was removed without the slightest exertion. This is the neatest and safest way to remove stoppers from bromine bottles and other corrosive chemicals.

MINIATURE RAILROADS FOR COUNTRY TRANSPORTATION.

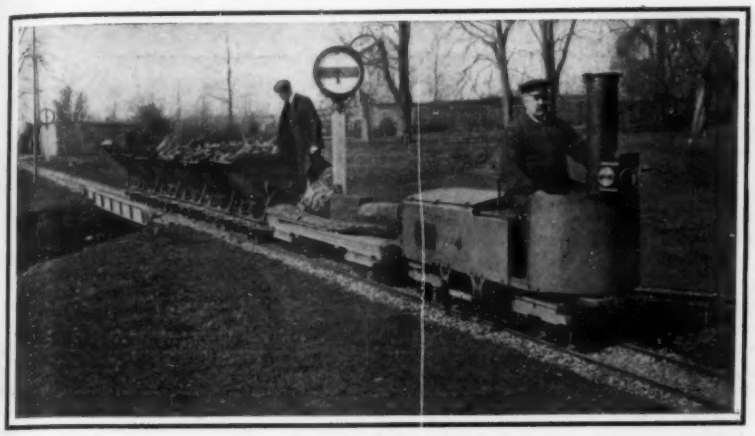
BY THE ENGLISH CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

During the past few years an interesting development has taken place in Great Britain in the provision of improved traffic facilities for the transport of both passengers and freight upon the extensive estates surrounding the country seats of eminent personages. As a general rule, these residences are remote from the trunk railroads; and owing to their rural situation, the facilities for traveling between the mansion and the main railroads are confined to the highroads by ordinary horsed vehicles. Moreover, the estates themselves are often very extensive, covering an area of several square miles, so that access to different points thereof is slow.

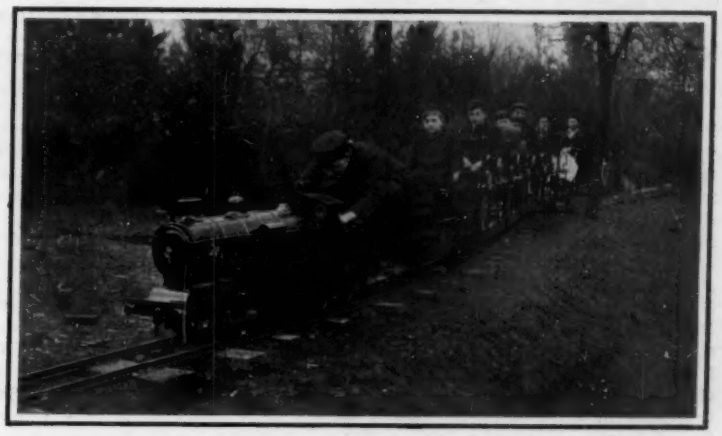
To overcome these disadvantages, several private owners have laid down what may be best described as "miniature railroads," which have long been familiar sights at Coney Island and other American resorts, and which extend from the immediate precincts of the residence to the nearest station on the trunk railroad system, for the rapid and convenient inter-transportation of passengers and freight. The most notable of these private diminutive railroads are those at Eaton Hall in Cheshire, the country seat of the Duke of Westminster; Duffield Bank, the home of Sir Percival Heywood, Bart.; and Blakesley Hall, where resides Mr. C. H. Bartholomew, a retired civil engineer and contemporary of the Stephensons. In addition, in various parts of the country short systems upon the same principle have been laid down, notably at Blackpool and Sutton Coldfield, for the supply of convenient public traveling facilities where none other exist.

These railroads are not mere toys, but exact replicas upon a reduced scale of the ordinary standard systems of the country, correct in every particular, including track, signaling equipment, rolling stock, etc.

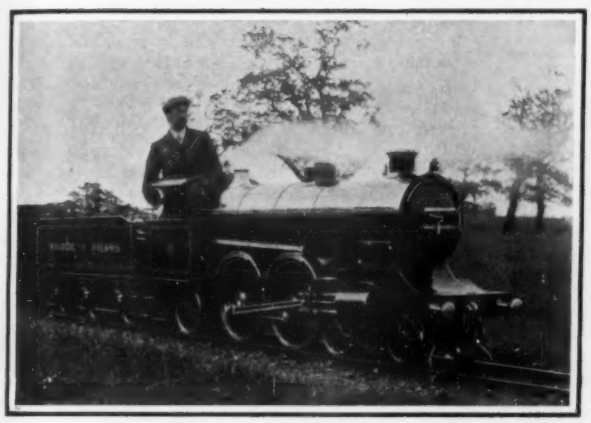
The miniature railroad at Duffield Bank was designed and constructed by its owner, Sir Percival Heywood, who is a recognized authority in such work and is an enthusiastic advocate of light railroads. This particular line is one mile in length exclusive of sidetracks, extending through the estate. The gage is 15 inches. The track alone cost $4,500. In its course the line passes through three tunnels, traverses two bridges of the wooden trestle type, and a timber viaduct of 90 feet in length by 20 feet in height. There are six stations along the route, which conveys guests to the various parts of the estate, and at each accommodation is provided for the housing of the cars and for waiting passengers. A regular scheduled service is maintained during the day. In addition to the conveyance of passengers, it is used for the transportation of wood, garden and other produce, and freight to the house. The freight cars measure 5 feet in length by 2 feet 6 inches wide and carry a maximum load



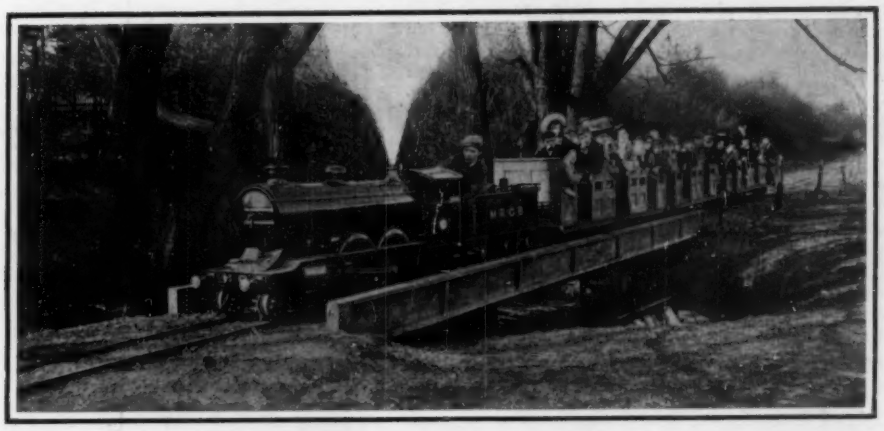
The Blakesley Hall gasoline locomotive hauling a freight train.



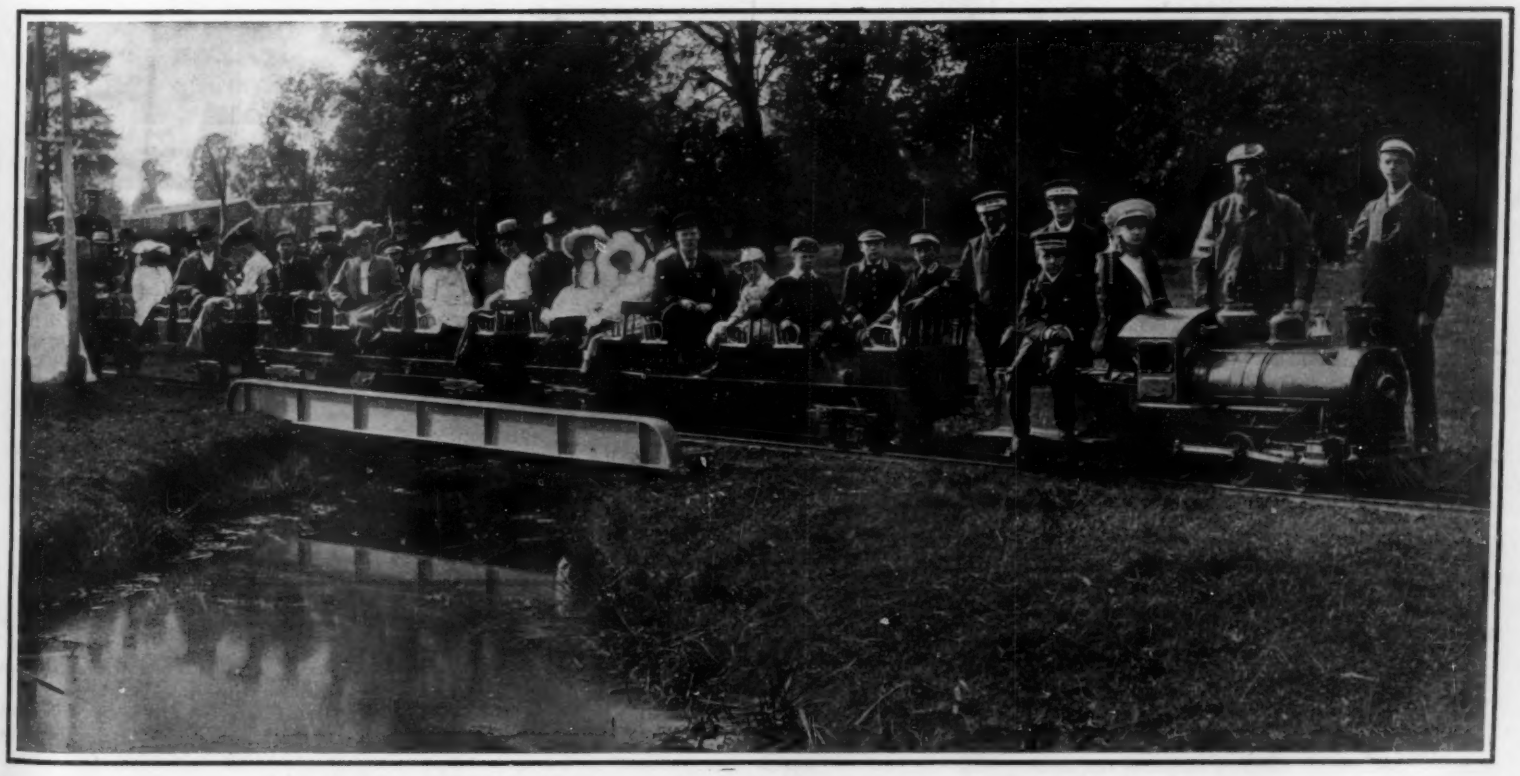
Tank locomotive hauling passengers on the Sutton Coldfield railroad.



A miniature "Atlantic" locomotive.



The 15-inch gage locomotive of the Sutton Coldfield road.



Passenger train on the Blakesley Hall miniature railroad. The rolling stock is all of the American type.

of 1½ tons. In addition there are numerous passenger coaches and a large baggage car, 15 feet in length. The railroad is provided with extensive workshops, in which all repairs to locomotives and rolling stock are carried out. At one point there is a remarkable three-quarter circle curve of 40 feet radius, to enable the line to gain a higher level. On festive and other occasions, when the house is full of visitors, special passenger trains are run, comprising eight bogie coaches capable of seating 120 persons.

The private railroad of the Duke of Westminster is of a more ambitious character. It runs through the Eaton Hall estate, and links the residence with the trunk railroad system at Balderton, 3½ miles distant. This line was also designed and constructed by Sir Percival Heywood, and is also of 15-inch gage. The whole system comprises 4½ miles of track, including the direct through line, 3½ miles long, and approximately 1 mile of sidetracks. The track is built upon the latest approved style with Vignole rails, averaging 12 pounds per yard, laid on longitudinal wooden cross-ties, and cost exclusive of buildings and rolling stock $6,545 per mile, representing an outlay of over $29,450 in track alone. The gradients vary from 1 in 100 to a maximum of 1 in 65. This railroad is essentially employed for the transport of freight to and from the house, though members of the family and their guests travel between the main-line station and the mansion, there being for such purpose a number of open vehicles and a bogie parlor car capable of seating 16 persons. There are two engines of special design and of low build. They are made with tubular axles and special joints so arranged that an eight-coupled engine can negotiate a curve of 25 feet radius without necessitating any special modification in the motion. The engines in use are four and six-coupled respectively, the former having cylinders of 5 inches bore with a stroke of 8 inches. The second engine, which is that most generally employed, has an over-all length of 10 feet with a width of 3 feet 10 inches, cylinders of 5½ inches bore and 8 inches stroke, and wheels 16 inches in diameter. The heating surface of boiler is 80 feet, and grate area 3 square feet, the working pressure being 175 pounds, at which 60 indicated horse-power is developed. The weight of the engine is 3¾ tons empty and 4½ tons in working order. Bunker capacity for 112 pounds of coal is provided, together with 77 gallons of water. The coal consumption ranges from 280 to 390 pounds per day, according to the work accomplished. The average speed attained with a normal load of 19 tons approximates 11¼ miles per hour, and the cost of running with freight is about 25 cents per ton mile. The engines were also designed by Sir Percival Heywood, and are fitted with his special correcting motion for the Joy valve gear.

The utility of such a railroad as this in connection with such a country seat, and the heavy work it has to fulfill, may be gathered from the fact that the trains cover a mileage of some 5,000 miles, and transport over 6,000 tons of freight per annum. When the house is full, over 40 tons of coal are consumed for domestic purposes per week, and the train conveys over 2,000 tons of coal from the trunk railroad system to the house in the course of the year. The miniature railroad runs into a sidetrack at the station on the main line, and all freight destined for Eaton Hall is transshipped directly thereto. The staff comprises the locomotive engineer and brakeman for the train service, together with two men for the maintenance of the track. The working expenses average $3,500 per annum exclusive of wages for staff, of which some $1,500 represents maintenance charges on track and rolling stock, $150 for locomotive stores, oil, coal, etc., and the balance interest on capital outlay, allowances for depreciation, etc. From this it will be seen that the cost of operating a railroad such as this upon a private estate averages some $62 per week.

On the Blakesley Hall railroad, owned by Mr. C. H. Bartholomew, both steam and gasoline motor traction is employed. This railway also links the private house with the trunk system, there being a sidetrack at the latter station for the smaller railroad. The gage is likewise 15 inches, and the line about a mile in length including sidetracks, a circular loop and triangle to avoid turning the locomotive on a turntable. The rolling stock is American throughout, the locomotive being of the standard 4-4-0 class reproduced on a 2-inch scale. The passenger coaches are of the bogie type, each having seating accommodation for 12 persons, and the engine is capable of hauling a train of three coaches, carrying 36 passengers, with ease. The cars were originally four-wheeled vehicles, but the owner rebuilt them, using three of the former bodies to make one coach. This alteration proved very successful, since running was appreciably improved on both curves and straight road. In addition there is also a double bogie truck or trolley for conveying heavy baggage and freight between the station and the house. Unlike the majority of such private railroads, this line is at times opened to the public, and is well patronized on such occasions.

The road, which was built by the owner himself, who is a civil and railroad engineer, is especially well carried out. The rails of flat-bottomed Vignole pattern, weighing 12 pounds per yard, are laid on pressed-steel ties. Care has been exercised to keep the grades as easy as possible, the maximum being about one per cent, which requisition, however, entailed heavy embankment and cutting work. Because a stream winds through the estate, extensive bridging became necessary. The bridges are of the girder type. The line is provided with an elaborate electric signaling equipment together with telephonic communication.

THOMAS CHROWDER CHAMBERLIN.

BY MARCUS BENJAMIN, PH.D.

It has been a frequent practice in the American Association for the Advancement of Science to choose for its president a resident of the place at which it was holding its meeting at the time of the election, or of the place at which it was next to meet. The former course was followed at the gathering held in Chicago last winter; for at that time Prof. Thomas C. Chamberlin, who is one of the foremost leaders in geology, was elected to preside over the meeting to be held in Baltimore this week.

Thomas Chrowder Chamberlin was born in Mattoon, Ill., on September 25, 1843, and was educated at Beloit College, where he received his bachelor's degree in 1866, and also that of master two years later. During the year 1868-9 he pursued a post-graduate course at the University of Michigan, devoting himself chiefly to studies in science.

He began his life-work as a teacher immediately on graduation, for in 1866 he became principal of the High School in Delavan, Wis. In the autumn of 1869, after finishing his studies at Ann Arbor, he was called to the chair of natural science in the State Normal School in Whitewater, Wis., and remained there for four years. His *alma mater* recognizing his promise in geology, and familiar with his success as a teacher, sought his services, and for nine years, from 1873 to 1882, he was professor of geology in Beloit, which chair he relinquished in order to give more exclusive attention to field work in geology. His success as an administrator was so conspicuous, that in 1887 the growing University of Wisconsin called him to its presidency, and in that capacity he continued until 1892, when on the organization of the University of Chicago he was made head of the Department of Geology and director of the Walker Museum, which places he still holds.

THOMAS CHROWDER CHAMBERLIN.
President of the American Association for the Advancement of Science.

His active work in geology has been most conspicuous. In 1873, the year he went to Beloit, he was appointed Assistant State Geologist of Wisconsin, and three years later he became Chief Geologist of the State, having among his associates Roland D. Irving, Charles R. Van Hise, Rollin D. Salisbury, and others who have achieved distinction in their specialties. Prof. Chamberlin devoted his own attention chiefly to studies on glaciers and glacial formations, on which subjects he is now recognized as the first authority in this country. His eminence in this field led to his appointment in 1882 as geologist in charge of the Pleistocene Division of the U. S. Geological Survey, which he has since retained. He has continued his interest in the Wisconsin Geological and Natural History Survey, of which since 1903 he has been a consulting geologist. In 1904 he served as geologist on the Peary expedition, and also in that year he was made a Commissioner of the Geological Survey of Illinois.

His major publications are more than a hundred in number, and embrace important contributions on the subject of education, as well as annual reports on the geology of Wisconsin and papers on topics pertaining to the glacial period in this country and abroad, and latterly he has written with the accumulated knowledge of years and experience, on fundamental problems of geology, especially on the history of the atmosphere, the planetesimal hypothesis, and the early history of the earth. In book form he is the author of "Geology of Wisconsin" (vol. I, Madison, 1883) and with Rollin D. Salisbury of a "Treatise on Geology" (3 vols., New York, 1904-1906). The Journal of Geology was founded by him and his associates in Chicago in 1892, and he has been its chief editor since that time.

The universities of Michigan and Wisconsin have conferred on him the degree of Ph.D.; the University of Illinois has given him its Sc.D., and Michigan, George Washington, Beloit, and Wisconsin have honored him with the degree of LL.D. Other activities of worthy mention include his appointment by the State of Wisconsin as its representative to the World's Fair held in Paris in 1878, and at which he received a medal for his geological publications, and also he was given a similar award at a more recent exposition held in Paris. He has served the Carnegie Institution in Washington as one of its research associates since 1902, and is therefore consulted by that institution on all awards made in geology.

He was chosen president of the Wisconsin Academy of Science, Arts, and Letters in 1885, and again in 1886, and in 1894 was elected president of the Geological Society of America. Since 1897 he has been president of the Chicago Academy of Sciences. In addition to the foregoing he has been elected to honorary relationships in the Geological Society of Edinburgh, American Academy of Arts and Sciences, Geological Society of Washington, Geological Society of London, and New York Academy of Sciences, and since 1902 he has been a member of the National Academy of Sciences.

Prof. Chamberlin joined the American Association at the meeting held in Dubuque, Iowa, in 1872 and was advanced to the grade of fellow in 1877. He was chosen to preside over the section in Geology and Geography in 1885, and delivered an address at the Buffalo meeting, entitled "An Inventory of Our Glacial Drift." At the meeting held in Chicago in December last Prof. Chamberlin was elected to the highest honor in the gift of the Association, and his name worthily represents American science on that famous roll of honor which began in 1848 with the name of William B. Rogers, likewise a geologist and also distinguished as an educator.

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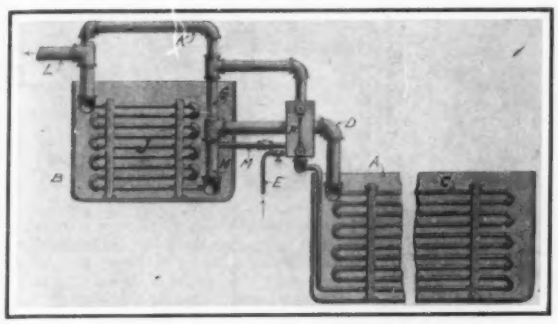
The Congress of Applied Chemistry.

The Seventh International Congress of Applied Chemistry will be held in London from May 27 to June 2, 1909. The president of honor is Sir Henry Roscoe, the active president Sir William Ramsay, Mr. McNab is general secretary, and Messrs. Thomas Tyrer and C. Whitman are treasurers. Dr. Harvey W. Wiley of Washington, D. C., has been appointed the chairman of the American committee. All who are interested in promoting the applications of chemistry are eligible for membership in the congress. The price of membership is one pound for men and fifteen shillings for women. American chemists intending to become members should send their check for $5 either to the chairman of one of the sections or direct to the chairman of the American committee at Washington, who will transmit the same to the proper official in London. Those intending to present papers should write to the chairman of the section to which the paper belongs. Papers should be neatly typewritten on thin piper, and be in the hands of the chairman of the American committee not later than April 1, 1909, in order to be forwarded to London for translating and printing.

Patent Department

IMPROVED REFRIGERATING APPARATUS.

The refrigerating apparatus which we illustrate herewith is arranged to maintain the expansion coils substantially filled with the liquid ammonia, and to prevent the return of the ammonia in a liquid form to the compressor. In connection with the main expansion coils there is an auxiliary coil, which is adapted to preliminarily cool the water to be frozen,

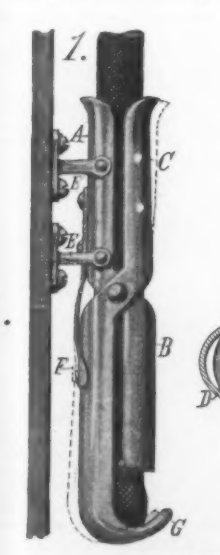


IMPROVED REFRIGERATING APPARATUS.

and this coil is connected to the rest of the system in such manner that the liquid and gas from the expansion coil are separated, and only the liquid is delivered to the preliminary cooling coil. In the illustration the tank in which the main expansion coils are located is indicated at *A*, while the preliminary cooling tank is shown at *B*. The liquefied ammonia is fed to main expansion coils *C* through the high-pressure conduit *E*, and the discharge takes place through the pipe *D*. The pipe *D* connects with a vertical conduit, one branch *H* of which communicates with the preliminary cooling coils *J*, while the other branch *G* connects with the conduit *K*, and thence by way of pipe *L* to the compressor. Such of the ammonia as reaches the vertical conduit in a liquid form from the main cooling coils, will drop into the branch *H*, while the gas will pass up by way of the branch *G* to the compressor. Inserted between the high-pressure conduit *E* and the coil *C* is a chamber *F*, provided with a gage glass, whereby the operator can observe the height of the liquid. The ammonia is cooled by its own vaporization in this chamber *F*, so that at the time it enters the expansion coils it is at a very low temperature. Any gas which may form from the vaporization of the liquid in the chamber *F* will pass directly to the compressor through a pipe leading from the top of the chamber. In case too large a quantity of liquid is carried from the expansion coils to the preliminary cooling coil, so as to raise the level of the liquid in the latter dangerously near the level of the pipe *D*, a valve may be opened in the branch pipe *M*, permitting the liquid in the coil to flow into the chamber *F*, and thence again to the main expansion coil. Mr. John D. Mayhew, of Tyler, Texas, has been granted a patent on this refrigerating apparatus.

WHIP SOCKET.

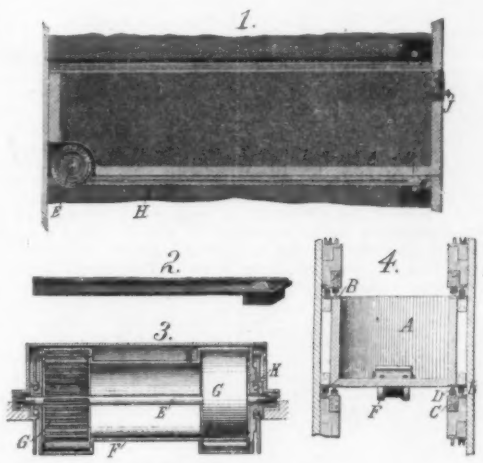
A new form of whip socket has recenty been invented, which will securely hold the stock of a whip in such manner that there will be no chance of its falling out. The whip is normally clamped in the socket, but may be released whenever desired by foot pressure. As shown in the engraving, the device consists of two members hinged together at their center. One of the members is formed with upper and lower concaved sections *A* and *B*, which are offset so as to bear on opposite sides of the whip. Mating with these sections are two similar sections *C* and *D* of the other member, the whole comprising a cylindrical tube. The whip socket is secured to the dashboard by means of a pair of brackets *E*, which are riveted to the section *A*. Mounted on the section *A* is a leaf spring *F*, the free end of which bears against the lower section *D* of the opposite member. Normally, the whip is held in place by the pressure of this spring *F*, which clamps the members together. The lower section *D* is formed with an extension *G*. The whip socket is mounted on the dashboard, with the extension *G* conveniently near the floor of the vehicle, so that the driver can press the extension with the toe of his foot to rock the socket members apart to the position indicated by dotted lines. This will release the whip. A patent on this whip socket has been granted to Mr. George F. Stanfield, 2326 Laurel Street, New Orleans, La.



WHIP SOCKET.

SPRING DRAWER.

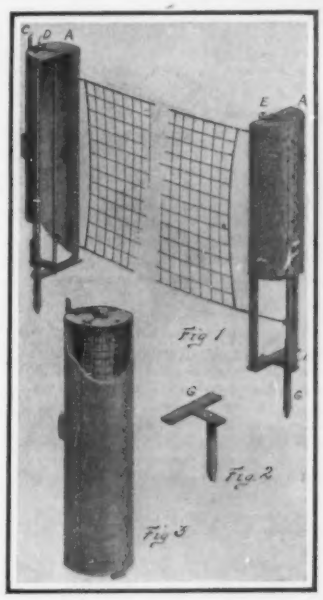
The drawer which is illustrated in the accompanying engraving is so arranged that when it is closed, a spring mechanism is operated, which serves to automatically open the drawer on the release of a latch. The drawer is particularly adapted for use with desks, writing tables, and the like, and means are provided for adjusting the tension of the spring according as the contents of the drawer are heavy or light. The body of the drawer is indicated at *A* in the engraving. At the rear corners of the drawer there are grooved rollers *B*, mounted in plates at the top and bottom of the drawer. These rollers travel on tracks formed on plates *C*, which are secured to the desk frame. At the forward end of each plate *C* a roller *D* is mounted, which engages a track formed on the plates carried by the drawer. The rear end of the drawer is cut away to form a recess, in which the spring mechanism is mounted. This comprises a fixed shaft *E*, on which is supported the drum *F*, formed at each end with casings in which spiral springs *G* are mounted. One end of each spring is secured to the shaft *E*, while the other is fastened to the drum. Coiled about the drum *F* is a cord *H*, which is secured to a hook at the forward end of the desk frame. The drawer is held in its closed position by means of a latch *J*. The latch is released by pressing a button, whereupon the springs *G* rotate the drum *F*, winding up the cord *H*, and sliding the drawer outward. When the drawer is closed, the action is reversed, the rope unwinding from the drum and placing the springs under tension. A ratchet mechanism *K* is provided at one side of the drum, to hold the latter while the spring is being adjusted for lighter or heavier loads. This ratchet mechanism is normally thrown into an inoperative position. The inventors of this spring drawer are Messrs. W. Lambert and E. P. Dopps, Box 206, North Yakima, Wash.



SPRING DRAWER.

COMBINED CASE AND POST FOR TENNIS NETS.

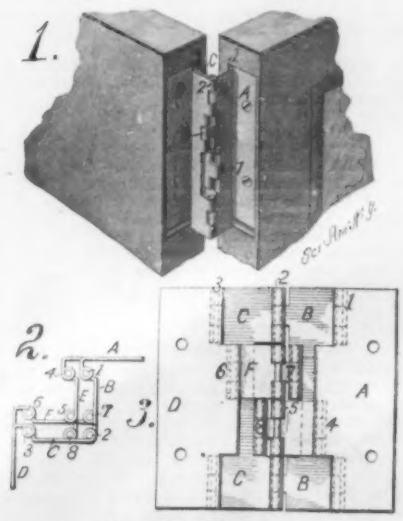
The accompanying engraving illustrates a case for lawn tennis nets, which is made up of two sections that may be set up as posts to support the net in the game. The case is made up of two semi-cylindrical sections *A*, in one of which is mounted a vertical shaft *B*. The latter projects through the opposite ends of the section and terminates in a crank *C*. To this shaft one end of the net is secured, and on it the net may be wound by operating the crank. A latch *D* is mounted on the upper end of the case, to hold the crank when the net has been wound thereon. The opposite end of the net is secured in the other section of the casing. The two sections are held together by means of hooks *E*, which attach to the projecting ends of the shaft. Each section is provided at its lower end with a plate *F*, having a transverse slot therein and adapted to engage a footpiece *G*, which is driven into the ground. The form of this footpiece is illustrated in Fig. 2. It will be observed that it is formed with a broad bearing plate, on which the forward part of the case-section rests, while the heel projects through the slotted plate, serving to hold the case-section in vertical position. The net may be tightened by operating the crank which is secured by means of the latch. The inventor of this device is Mr. Lester H. Atwell, of Grove City, Pa.



COMBINED CASE AND POST FOR TENNIS NETS.

AN IMPROVED HINGE.

Pictured in the accompanying engraving is a hinge of the class known as butt hinges, which is arranged to fold into recesses in the edge of a door and the corresponding edge of a casement, where it will be concealed, permitting a close folding of the door at the hinged edge. The construction also allows the door to be completely open, so as to lie flat against the casement and adjacent side walls. Fig. 1 shows one side of the hinge, while in Fig. 3 the hinge is inverted, showing the reverse side. The hinge is composed of six leaves lettered *A*, *B*, *C*, *D*, *E*, and *F*. The leaf *A* is secured to the door, and the leaf *B* to the casement. The leaf *B* is hinged to the leaf *A* at 1, and to leaf *C* at 2, the latter leaf being hinged to the leaf *D* at 3. The leaves *E* and *F* are hinged to the leaves *A* and *B*, respectively, at 4 and 6, while they are connected together at 5. The leaf *F* has an extension which is hinged to the leaf *B* at 7, while leaf *E* has an extension hinged to leaf *C* at 8. The effect is virtually that of a lazy tongs. It will be evident that the leaves *B* and *E* are held in parallelism, and the leaves *C* and *F* are also held in parallelism, so that any movement of any leaf section in respect to any other leaf section causes a definite and predetermined movement of each of the other leaf sections. All of the leaves are permitted to fold together compactly within the recesses of the casement and door. Mr. William Boyd Rodman, of 4 King Street, Charleston, S. C., has obtained a patent on this novel hinge.



AN IMPROVED HINGE.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRICALLY-OPERATED GUN CONTROL.—J. B. RYAN, Hoboken, N. J. This invention relates to gunnery, the more particular object being to provide means for readily enabling a heavy gun to be maintained as nearly as practicable in proper position to fire at a target, notwithstanding motions of a vessel upon which the piece may be mounted.

Of Interest to Farmers.

BERRY-HOLDER.—W. A. DAY, Bellingham, Wash. In operation the third and fourth fingers of the wearer are inserted in the loop formed by a strap and a strap buckled around the wrist of the same hand. Each hand may be if desired supplied with a holder, and as the berries are picked from the briars by the thumb and first two fingers, they are dropped into the holder, which when full is emptied into a larger receptacle.

Of General Interest.

PROCESS OF MANUFACTURING STEEL.—W. R. WALKER, Chicago, Ill. This is a process whereby a spiegel having especially its manganese and as well its carbon and silicon contents more thoroughly and uniformly distributed therethrough can be obtained without the necessity of melting the spiegel within a cupola. It enables spiegel to be suitable as a recarburizing addition to the charge of a Bessemer converter or like refining chamber, to be produced from low grade ores.

BEEF-TRUCK CRADLE.—C. A. PARKERSON, Jr., New York, N. Y. Means are provided for handling the trucks or travelers used in slaughter-houses, packing houses, and the like, for supporting the dressed meat or other bodies from the overhead tracks, and the invention relates more particularly to a cradle for engaging with the roller of the truck for raising the latter and depositing the same upon the overhead track.

SUBSTITUTE FOR PATENT-LEATHER.—S. NATHAN, New York, N. Y. The improvement is in material adapted to be used as a substitute for patent leather and the process by which the material may be manufactured. It is adapted for use for all purposes for which patent leather is normally employed, but is more particularly adapted for use in the manufacture of ladies' belts and similar articles requiring strength and durability.

APPARATUS FOR DETERMINING SPECIFIC GRAVITY.—F. A. COURTOIS, New York, N. Y. An object of the inventor is to provide an apparatus for determining specific gravities, particularly of liquids, which obviates the difficulties encountered in obtaining the hydrometer readings owing to the presence of the meniscus of the liquid under investigation.

BRUSH FOR WASHING BOTTLES.—C. K. VOLCKENING, New York, N. Y. In operation, the wipers are brought together and the ferrule carrying them is inserted in the bottle. A spindle being turned, studs and ribs are brought into contact with the interior of the bottle, cleaning it thoroughly, the water being forced into the bottle through the educts. The brush withdrawn, the conformity of the bottle neck forces the wipers toward each other, thereby pressing the spring slightly. The brush completely removed, this spring and the wipers regain normal positions.

BREECH-PROTECTOR.—E. L. HANN, Dec'd, Denton, Texas. The objects of the invention are to provide means for protecting the exposed breech ends and other adjacent parts, and for protecting the hands of the person cleaning or handling the same. It comprises a protecting cover, and means for removably attaching it to the breech of the barrel or frame of a gun.

PHOTOGRAPHIC SHUTTER.—H. A. BYERS, Pe Ell, Wash. The invention improves on a patent formerly granted to Mr. Byers, to the extent that the means used for varying the relative exposure of the plate, so that the sky portion and foreground will be exposed to actinic action of rays of light different lengths of time, will be greatly simplified, and wherein speed regulation, with reference to reduced or prolonged exposure of sky or foreground, can be quickly and conveniently made, it being also possible to effect a passage of the shutter across the entire lens at uniform speed to obtain rapid, instantaneous exposure.

Heating and Lighting.

AUTOMATIC LAMP-EXTINGUISHER.—C. OLDER, W. S. GEARHART, and H. E. BILGER, Springfield, Ill. The particular purpose of the invention is to provide an approved construction containing a wick snuffer co-acting in connection with a weight, to extinguish the flame whenever the lamp is thrown over on its side or is inclined beyond certain limits in any direction.

Household Utilities.

ICE-CREAM PACKER.—E. C. A. JOHNSON, Virginia, Minn. The device is readily applied for use in holding a receptacle for ice cream in proper position in a cabinet, bucket, or tub during the packing of the receptacle with ice and salt, and to so construct the device that the ice and salt received thereby will be conducted to the space between the receptacle for cream and the cabinet, without danger of the packing entering the receptacle.

FLY-PAPER HOLDER.—J. O. FORKER, New York, N. Y. The special purpose here is to provide a base which may be used alone, for holding a sheet of paper and preventing the adhesive material from flowing, or which may be used in conjunction with a cage of coarsely woven wire, which latter protects the paper from above. The cage is so constructed that when detached from the base it may flatten out to occupy the minimum space.

COOKING UTENSIL.—F. R. MAZZA and C. M. DALY, New York, N. Y. The invention relates more particularly to that type of vessel in which there is provided an overhanging flange or projection beneath which the handle may be inserted for lifting the vessel. The object is to provide means adapted to co-operate with the handle, so that the vessel may be inverted without its becoming separated or detached from the handle.

Machines and Mechanical Devices.

STUMP-SAWING MACHINE.—E. B. WEBSTER, La Crescent, Minn. The objects of the improvements are to provide facilities for positioning the saw with respect to the object on which it is directed; to provide means for expediting the erection and removal of the device and the power transmission therefor; and to insure durability of the working parts and the entire structure in proportion to the weight thereof.

FRICTION-CLUTCH FOR HOISTING-DRUMS.—F. N. WHITCOMB, Barre, Vt. In this case the invention relates to certain improvements in hoisting drums, and particularly to the means of operating the clutch thereof. The invention involves the structural details of this operating member and the means for controlling the same.

TRIGGER MECHANISM.—E. F. HEDRICK, Fort Bayard, New Mex. This patent discloses a mechanism in connection with the sears and trigger whereby provision is made for locking the trigger as may be desired for using the trigger mechanism in plain trigger position or so as to arrange the mechanism for set trigger position. The devices include safety means for effectually locking the parts in their adjusted positions.

Railways and Their Accessories.

AIR, STEAM, AND SIGNAL COUPLING.—E. B. WITTE, Trenton, N. J. The invention relates to improvements in couplers for use in connection with air brake systems, train signals, and steam heating systems, and involves means whereby when a car is detached from the train, the valves of the car will close to retain sufficient air in the cylinder and pipe line of the car to hold the brakes in release position and permit the car to move by its own momentum to the desired point.

CAR-STAKE.—A. B. LITTLE, Atlanta, Ga. The invention contemplates a stake preferably constructed throughout of malleable iron and forming a permanent part of the car, which may be readily changed from a rigid upright position to a removed depressed position or vice versa as desired, thus effectively retaining the load and permitting its discharge without undue inconvenience.

CATTLE-GUARD.—A. M. HOWERY and J. B. CLARK, Eastbank, West Va. The purpose of the invention is to provide a construction for a cattle guard, that will effectively prevent the crossing of a railroad track by cattle or other animals that avoid traverse of insecure supporting surfaces.

Pertaining to Recreation.

JUMPING-ROPE HANDLE.—C. H. SAPPER, Highlands, N. J. In this instance the invention relates to jumping rope handles, and has for its object the provision of the handles of a jumping rope with music boxes, so constructed as to be operated by the user when the rope is in use. A further object is to provide reversible means for operating the boxes.

ROLLER-SKATE.—J. L. PLIMPTON, Boston, Mass. The invention relates to guidable curved-running roller skates formerly patented by Mr. Plimpton in the U. S. and England. In this class the rollers are applied to the stock or foot-stand of the skate so that the said rollers may be cramped or turned, so as to cause the skate to run in curved lines, either to the right or left by the turning, canting or tilting laterally of the stock or foot-stand.

Pertaining to Vehicles.

TIRE-PROTECTOR.—H. M. LEESE, Washington, D. C. In the present patent the invention is an improvement in tire protectors having for its object the provision of new tires and tires that have become worn and which can be readily applied to and removed from the tire. The wheel to which the tire is adapted may be of an ordinary construction.

SHOCK-ABSORBER FOR VEHICLES.—E. E. LANTZ, Paris, France. Inconveniences like the hard riding of a carriage; the shearing of the suspension springs; the frustration of their useful effect; the necessity for continually adjusting the suspension by reason of the wear of the frictional parts, the impossibility of applying them to heavy vehicles, etc., are avoided in this shock-absorber. It is adapted to all kinds of vehicles and can be regulated for all suspension springs whatever be their strength.

SPINDLE-UPSETTING DEVICE.—S. L. BLAKE, Paducah, Ky. The purpose of the invention is to provide a construction for a device adapted to stave up or upset a vehicle axle spindle, by longitudinally applied compression, whereby a worn spindle may be restored to its original diameter and close fit within a box in a wheel hub when it is rotatably secured upon the spindle.

PORTABLE FARE AND TICKET RECEPTACLE.—E. J. VARGYAS, New York, N. Y. The receptacle or box is mainly designed for the use of conductors of street cars and other vehicles, and is arranged to provide compartments for the reception of the fare received to allow of conveniently making change, to register the number of fares received, and to provide for the issuance of trip or transfer tickets.

ELASTIC-TIRE WHEEL.—A. D. FOUCART, Muncy, Pa. The invention is an improvement in means for securing pneumatic and solid rubber tires to the rims of wheels, particularly such as are intended for use on automobiles, bicycles, and traction engines. The means employed enable the tire to be readily applied or detached and yet hold the same securely.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

Full hints to correspondents were printed at the head of this column in the issue of November 14 or will be sent by mail on request.

(11066) The S. P. P. Co. says: We are building a two-revolution printing press, one that has a printing capacity of 2,000 per hour. We are thinking of babbitting the main driving-shaft bearing. Will you write us a letter advising as to the durability of babbitt bearings? A. Without any *especial* knowledge of the mechanics of printing presses, we cannot see any objection to the use of babbitt for the purpose you mention. The practice of lining journal boxes with a metal that is sufficiently fusible to be melted in a common ladle is not always so much for the purpose of securing anti-friction properties as for the convenience and cheapness of forming a perfect bearing in line with the shaft without the necessity of boring. Boxes that are bored, no matter how accurately, require great care in fitting and attaching them to the frame or other parts of a machine. In this respect it is a good and economical practice to use babbitted boxes, but the shaft should not be used for the purpose of casting the bearings, as the hot metal is apt to spring it, and a mandrel of the same size as the shaft or very slightly larger should be used. Care should be used in the selection of the babbitt, according as the bearing is to carry heavy, slow-running shafting, light, high-speed shafting, or any other combination. Very few metals sold as babbitt are made up according to the original formula, which consisted principally of tin and some copper and antimony, and many are simply refuse from type foundries and similar sources cast into fancy ingots and given an attractive name with no reference to their wearing qualities. For wearing properties, with a moderate speed, nothing is better than pure zinc, of which the only disadvantage is that its shrinkage in cooling inclines it to leave the box, so that it is generally mixed with another metal. Tin counteracts this shrinkage, and an alloy of eight parts zinc and two parts block tin has excellent wearing qualities for speeds not over 400 R. P. M. and withstands very heavy loads without crushing. Lead and antimony combine well in any proportions without reducing the anti-friction properties of either; an alloy of 80 parts lead to 20 parts antimony runs freely in the melted state, has practically no shrinkage on cooling, is much harder when cold than most bearing metals, and there is nothing better as an anti-friction metal for high-speed boxes. Care should be used in pouring it, and it should never be heated hotter than will scorch a dry pine stick. Reliable makers of bearing metals will quote you material especially suited to the speed and weight of your shaft.

(11067) H. T. C. writes: I have read the letter of G. L. P., No. 10094, and your reply with a good deal of interest. If G. L. P. will figure out the areas of the triangles and polygons that he has himself marked out, he will see that the areas of the two triangles *A B E* and *E B F* are 12 square inches each, making 24 square inches, and the areas of the polygons *E G H C* and *G F D H* are 20 square inches each, making 40 square inches, or a total of 64 square inches, which is just the same as the 8 x 8 inch square was to begin with. It seems absurd for anyone to say that changing the positions of several pieces of paper will make any one of the pieces grow larger, but this is evidently just what G. L. P. did say. How he can make the pieces grow larger after cutting them up than they were before is of course due to the sleight of hand you mention; only in his case, instead of making the audience believe he has been cutting off a man's head, he makes them think, by his bad drawing, that he has gained one square inch in the process of cutting up.

(11068) C. C. S. asks: 1. Is it known what the air 20 miles from the earth is composed of? A. It is not known with certainty what the constituents of the air are at 20 miles above the earth's surface. No balloon has attained that altitude to collect air. 2. Is it possible to make the same on the face of the earth? A. If the composition of the air at any place were known, a compound exactly like that could be made in the laboratory. There are no unknown substances in the air unless in most minute quantities, so minute that they have not been detected by the most delicate analysis up to the present time. 3. Would it take more or less power to sustain the same given weight at a height of two miles from the earth's surface than it would to sustain the same weight at a height of but twenty feet? A. The sustaining power of the air is much less at two miles above the earth than at sea level. At three miles above sea level the sustaining power of the air is only half that at sea level. It will therefore require more outside power to sustain a body at two miles above than at the surface of the earth. The sustaining power of the air is proportional to its density. A cubic foot of air at normal pressure and 32 deg. Fahr. weighs 1.225 ounces and can sustain that part of the weight of a cubic foot of anything. The rest of the weight of a cubic foot of anything must be sustained by some other power than the air.

(11069) E. L. S. asks: It being conceded by most astronomers that the earth and the other planets are bodies thrown off by centrifugal force from the sun, explain how it was that they took up an orbital motion at any fixed distance from the sun. In other words, as there was evidently a centrifugal force sufficient to cause them to leave the original mass, and as the gravitational force exerted upon them by that mass decreased as the square of their distance from it, why should they have ever come to rest in a prescribed orbit? What gave them their orbital motion, since a body acting under centrifugal force leaves the source of that force at a tangent and progresses in a straight line? A. The simplest case of tidal evolution is that of the moon and the earth. If that can be satisfactorily explained, the more complicated cases of the planets and the sun may perhaps be accounted for. When the moon separated from the earth, the rotation of the combined masses was supposed to be made in about five hours, so rapidly that the moon was in unstable equilibrium regarding the earth. In this condition it had little or even no weight toward the earth, and the sun pulled the moon off from the earth by a tidal action. The moon was going around the center of gravity of the earth and itself in about five hours according to this hypothesis, and the solar attraction caused it to move away from the earth while still it revolved around the earth. Its orbit in space then was a spiral, and it moved away from the earth, not in a straight line at all, but in a curve of which the center of the earth was one point or center or revolution. This interesting hypothesis is well stated in Moulton's "Introduction to Astronomy," which we send for $1.60.

(11070) W. W. C. asks: 1. What are the granules used in a regular telephone transmitter? I tried carbon, but it worked to little advantage; it had a loose rattling sound. A. The granules used in a telephone transmitter are of carbon graphite. They can be bought of different sizes from dealers in electrical goods. You cannot make them, unless you have some means of shaping them and polishing them after they have been made spherical. It is cheaper to buy the granules. 2. Can a plug gage of a given size be made to go into a cylindrical gage of the same size? If so, how? A. A plug gage can be made to go into a hollow gage by heating the hollow gage, thus expanding it somewhat. If they were of the same size, the plug could not be driven cold into the hollow gage without considerable force. 3. Is it absolutely necessary that a tungsten electric light hang vertical? If so, why? A. Tungsten lamps have thus far been hung vertically downward because the filament has been so flexible and brittle. Lately the makers of the lamp have advertised that they might be placed in horizontal sockets. We have our doubts as to their durability in any position excepting the vertical position.

(11071) A. G. asks: 1. Can the Southern Cross constellation be seen in this latitude 24 deg. north? If it can be seen, then in what month of the year? If it cannot be seen here, then what is the farthest north it can be seen? Is there another constellation somewhat similar to the Southern Cross? What is its name, and in what latitude seen? A. Alpha Crucis, the brightest and also the most southerly of the stars of the Southern Cross, attains an altitude of about 4 deg. above the horizon in latitude 24 deg. north. On a clear evening about April 1 it will be on your meridian at midnight. There are many configurations of stars similar to those of the Southern Cross. It consists of four stars in the form of a four-sided figure, the sides unequal, a trapezium, and would not suggest a cross at all excepting for one's fancy. Only one of these stars is of the first magnitude, and two are of the second magnitude.

(11072) C. W. asks: Will you please explain why the sun shines on the north side of a house two times a day, early in the morning and late in the evening? A. From March 22 to September 22 the sun rises north of the eastern point of the horizon and sets to the north of the western point of the horizon. For a time then during the morning and evening it is north of an east and west line through any house which stands north and south. It will during that time shine on the north side of such a house.

(11073) J. D. asks: A bullet fired from a rifle perpendicularly, at what rate of speed would this bullet return to the point at which it was fired—at a greater, less, or same rate of speed? B says it would return to the rifle at the same rate of speed as it had when it started or was fired. A. The air resists the flight of a bullet very sensibly. If it is fired vertically upward, then it will not rise so high as theory requires, and starting to fall from a lower altitude than it should have attained by theory, it will again fail to gain the velocity with which it began its flight. If there were no resistance of the air to encounter, the bullet would rise to the height given by its initial velocity, and in falling, would regain its initial velocity. B is not right.

(11074) S. F. M. says: I wish to know what is considered the average per cent of loss in producing electric light from the coal pile. That is, what per cent is lost in generating steam, then in the engine, then in the dynamo, and then in the light bulb. A. We would say that the statement is frequently made that an incandescent lamp has an efficiency of one per cent; that is, one per cent of the heat value of the coal is given back in light. The arc lamp is more efficient. The steam engine is usually given as about 15 per cent. The dynamo is about 90 per cent. The loss in wiring, etc., depends upon conditions of the local service. Sloane gives the efficiency of the arc as thirteen times that of gas. You will find much in his "Handy Book of Electricity" of value to you. We will send it for $3.50.

(11075) P. H. says: 1. The distances between graduations on mercury thermometers are uniform. Does mercury expand uniformly for each degree increase in heat? If not, is the thermometer (mercury) scale accurate? A. The rate of expansion of mercury with the rate of temperature increases as the temperature becomes higher, from which it follows that if a thermometer showing the dilation of mercury simply were made to agree with an air thermometer at 32 deg. and 212 deg. Fah., the mercurial would show lower temperature than the air thermometer between those points and higher temperature beyond them. For instance, according to Regnault, when the air thermometer marks 662 deg. Fah., the mercurial marks 683.89 deg. Fah., an error of 21.89 in the latter. Actual mercurial thermometers indicate intervals of temperature proportional to the difference between the expansion of the mercury and that of the glass; the latter corrects to some extent the errors arising from inequalities in the expansion of the mercury, so that for practical purposes the mercurial thermometer sensibly coincides with the air thermometer for all temperatures from a few degrees above the freezing point of mercury (—39 deg. Fah.) to about 500 deg. Fah., the errors in the ordinary atmospheric range of temperature being immeasurably small. 2. Is there any limit to the stellar universe? We say that the light from one star takes 20,000 years to reach us. Are there any stars farther away than this? If so, is there any calculable limit? A. Concerning matters which are immensurable, there is nothing which may be asserted with more assurance than that there are no calculable limits to the stellar universe. There is every reason to suppose that there are stars the light of which has not yet reached the earth though they may have been incandescent for countless ages; quite as probably if they or our telescopes are of sufficient magnitude for their light to be detected at all, the latter will continue to reach us for ages after the stars are extinct.

NEW BOOKS, ETC.

THE APPLICATION OF HIGHLY SUPERHEATED STEAM TO LOCOMOTIVES. By Robert Garbe. New York: Norman Henley Publishing Company. 8vo.; pp. 70; fully illustrated with folding plates and tables. Price, $2.50.

This book is a reproduction, carefully edited by Mr. Leslie Robertson, of a series of articles which appeared in The Engineer, the interesting and in some instances revolutionary views of the author being carefully preserved in this the first English version of the reason for as well as the results of the adoption of superheated steam on the Prussian State Railways, of which he is locomotive superintendent. The continually increasing demand upon modern rolling stock and the limitations imposed by bridge and permanent way restrictions make the problem of the locomotive superintendent of increasing the hauling power of his engines without materially increasing their weight a difficult one. The enormous increase of coal bills also directs the attention of the management to the necessity of economy in fuel; and the use of superheated steam at temperatures of 600 deg. Fah. and upward, ten years ago considered impossible at least on locomotives, seems from the experience of the Prussian State Railways to be the cheapest and simplest solution of the problem. Much of the success of that application is due to the care and enthusiasm of Mr. Garbe and the thoroughness of the German engineer is admirably exemplified in the manner in which he presents his experience and deductions in this book.

THE TEXT BOOK OF GENERAL BACTERIOLOGY. By Edwin O. Jordan, Ph.D. Philadelphia: W. B. Saunders Company, 1908. 8vo.; pp. 557. Price, $3 net.

This book is the outgrowth of lectures given to students in the University of Chicago during the past few years. The subject is one that the writer believes should find a place in every general scientific course. The book is chiefly of professional interest to the medical student, but the subject also bears technical relation to household administration, to agriculture, to sanitation and sanitary engineering, and the various industries and technological pursuits. For the general scientific student and reader bacteriology presents certain aspects that tend to widen the outlook upon a variety of human interests. The reader who wishes to acquire greater familiarity with the subject will find some bibliographical references given as a sort of first aid to the investigator. It is an excellent piece of book making, illustrated with well-executed engravings. It is well printed on good paper.

PRINCIPLES AND PRACTICE OF AGRICULTURAL ANALYSIS. Vol. II. Fertilizers and Insecticides. By Harvey W. Wiley, A.M., Ph.D. Easton, Pa.: The Chemical Publishing Company, 1908. 8vo.; pp. 680. Price, $4.50.

No one is better qualified to speak with authority than the Chief of the Division of Chemistry of the Department of Agriculture. In this volume an attempt has been made to treat the subject of fertilizers and fertilizing materials in the manner followed in the first volume with soils. The general principle of fertilizer manufacture and application have been presented in so far as they seem to throw light on the rational method of examination and analysis. The standard methods of analysis in use in this and other countries have been presented with sufficient fullness for the guidance of the skilled worker and the information of the student. This is the second edition of the book, and all the matter in the volume has been rewritten and brought down to date. New ventures of moment are those relating to the production of nitric acid for manurial purposes from cyanamid and by direct electric oxidation of nitrogen of air. A chapter on the analysis of insecticides has also been added. While not intended in any way as a library guide, Dr. Wiley hopes that this volume may be even more highly appreciated than in its first form by the student, the investigator, and the teacher.

"HÜTTE": DES INGENIEURS TASCHENBUCH. Proceedings of the Akademischen Verein Hütte. 3 vols. Berlin: Wilhelm Ernst & Son, 1908.

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THE APPLICATION OF HIGHLY SUPERHEATED STEAM TO LOCOMOTIVES. By Robert Garbe. New York: Norman Henley Publishing Company. 8vo.; pp. 70; fully illustrated with folding plates and tables. Price, $2.50.

This book is a reproduction, carefully edited by Mr. Leslie Robertson, of a series of articles which appeared in The Engineer, the interesting and in some instances revolutionary views of the author being carefully preserved in this the first English version of the reason for as well as the results of the adoption of superheated steam on the Prussian State Railways, of which he is locomotive superintendent. The continually increasing demand upon modern rolling stock and the limitations imposed by bridge and permanent way restrictions make the problem of the locomotive superintendent of increasing the hauling power of his engines without materially increasing their weight a difficult one. The enormous increase of coal bills also directs the attention of the management to the necessity of economy in fuel; and the use of superheated steam at temperatures of 600 deg. Fah. and upward, ten years ago considered impossible at least on locomotives, seems from the experience of the Prussian State Railways to be the cheapest and simplest solution of the problem. Much of the success of that application is due to the care and enthusiasm of Mr. Garbe and the thoroughness of the German engineer is admirably exemplified in the manner in which he presents his experience and deductions in this book.

THE TEXT BOOK OF GENERAL BACTERIOLOGY. By Edwin O. Jordan, Ph.D. Philadelphia: W. B. Saunders Company, 1908. 8vo.; pp. 557. Price, $3 net.

This book is the outgrowth of lectures given to students in the University of Chicago during the past few years. The subject is one that the writer believes should find a place in every general scientific course. The book is chiefly of professional interest to the medical student, but the subject also bears technical relation to household administration, to agriculture, to sanitation and sanitary engineering, and the various industries and technological pursuits. For the general scientific student and reader bacteriology presents certain aspects that tend to widen the outlook upon a variety of human interests. The reader who wishes to acquire greater familiarity with the subject will find some bibliographical references given as a sort of first aid to the investigator. It is an excellent piece of book making, illustrated with well-executed engravings. It is well printed on good paper.

PRINCIPLES AND PRACTICE OF AGRICULTURAL ANALYSIS. Vol. II. Fertilizers and Insecticides. By Harvey W. Wiley, A.M., Ph.D. Easton, Pa.: The Chemical Publishing Company, 1908. 8vo.; pp. 680. Price, $4.50.

No one is better qualified to speak with authority than the Chief of the Division of Chemistry of the Department of Agriculture. In this volume an attempt has been made to treat the subject of fertilizers and fertilizing materials in the manner followed in the first volume with soils. The general principle of fertilizer manufacture and application have been presented in so far as they seem to throw light on the rational method of examination and analysis. The standard methods of analysis in use in this and other countries have been presented with sufficient fullness for the guidance of the skilled worker and the information of the student. This is the second edition of the book, and all the matter in the volume has been rewritten and brought down to date. New ventures of moment are those relating to the production of nitric acid for manurial purposes from cyanamid and by direct electric oxidation of nitrogen of air. A chapter on the analysis of insecticides has also been added. While not intended in any way as a library guide, Dr. Wiley hopes that this volume may be even more highly appreciated than in its first form by the student, the investigator, and the teacher.

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Inquiry No. 8890.—For manufacturers of a milking machine.

Inquiry No. 8891.—For manufacturers of a patent vise with an attachment for boring small holes.

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Inquiry No. 8894.—For manufacturers of an automatic camera for making photographs on pin trays, etc.

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Inquiry No. 8897.—For the manufacturers of the "Lid on" can opener.

Inquiry No. 8898.—For manufacturers of kites.

Inquiry No. 8899.—For manufacturers of steel balls used for cutting sapphires or jewelry and also corn crisp used in cleaning and polishing sapphires.

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Inquiry No. 8901.—For the address of the Electrose Manufacturing Co.

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Inquiry No. 8907.—For address of New England Coil Winding Co.

Inquiry No. 8908.—For a dealer in tapes and cords for Venetian blinds.

Inquiry No. 8909.—For a machine to paint shade or blind rollers.

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Inquiry No. 8912.—Wanted to buy an apparatus for counting currency of different denominations.

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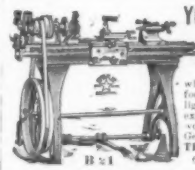

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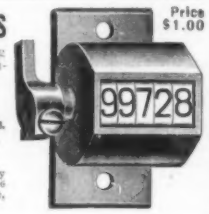

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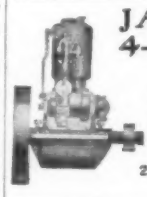

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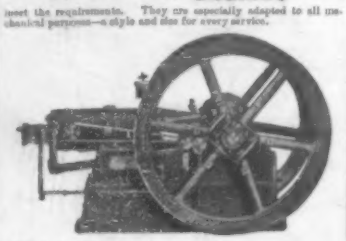

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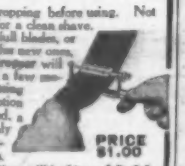

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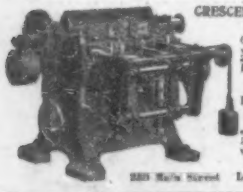

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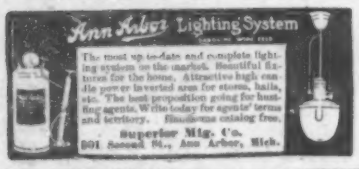

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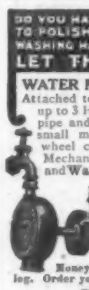

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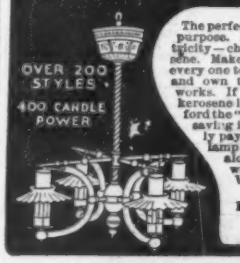

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